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AMERICAN AGRICULTURAL IMPLEMENTS

A Review of Invention and Development
IN THE
AGRICULTURAL IMPLEMENT INDUSTRY OF THE UNITED STATES

IN TWO PARTS

PART ONE: General History of Invention and Improvement

PART TWO: Pioneer Manufacturing Centers

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❖ INTRODUCTORY. ❖

THE year of the World's Columbian Exposition is a most advantageous time for issuing, in book form, a review of the development of the agricultural implement industry in America. To our improved methods in agriculture, more than to any other factor, excepting railroads, we owe the marvellous development of our resources during the past century, and a full share of the credit should be given to the inventors, beginning with Whitney just 100 years ago, who gave their lives, often in martyrdom, to the development of inventions, whose object was to make labor more effective in man's struggle with Mother Earth.

If we had none of our modern implements of planting, cultivation, harvesting and separation, Europe would look in vain to our shores for bread and clothing for her congested population, and the millions of our own cities would be to-day an ignorant peasantry.

Empires in the past arose and fell and their places were utterly forgotten, save to the scribe or philosopher, for the masses—men, women and children—were so enslaved to the soil that they were helpless, after their masters had slain each other in war or gone the way of dissipation. But in this nineteenth century man has been shaking off the shackles of manual toil, and has secured advantages of education and intercourse with his fellowmen that lay a firm foundation for the future and insure against a relapse, in America, at least, into another slough of ignorance and helplessness. It is fitting that, in our celebration of the achievement of Columbus in the discovery of America, we should also remember the inventors who by power of mind over matter have freed their fellowmen. To these, whom the historian of the future will call truly great, this brief review of their work is dedicated.

The author acknowledges with gratitude the kindness of C. W. Marsh, editor of the *Farm Implement News*, in authorizing the revision and use of his able historical articles published a few years ago. Mr. Marsh is well qualified to speak with authority in matters pertaining to the agricultural implement industry, as he was the inventor of the harvester, a machine which represents to-day more capital invested in its manufacture and use than any other single machine in the world, excepting the steam engine; and since retiring from its manufacture has been actively engaged for nearly ten years in editorial work that has kept him closely informed regarding the progress of every branch of the industry. It is to be regretted that Mr. Marsh could not have taken up this work, but editorial duties have pressed him too closely, and it has devolved upon the writer, who has undertaken it in the hope that four years' connection with Mr. Marsh's paper, nearly three years of that time as editorial assistant, has in some measure fitted him for the task.



PART I.

CHAPTER I.

The Development of the American Plow.

THE first agricultural implement used by prehistoric man, as shown by remains found in peat bogs of England, France and other countries, was a hooked stick, or sometimes a stag's horn, adapted to the work of digging and stirring the soil in planting seed. This rude tool—it can scarcely be called an invention—developed in course of time into something more like a plow, the forked stick with a long branch to which animals were attached, and perhaps an artificial brace added to strengthen the other branch used as the share or 'bottom.' This style has been found illustrated on an ancient monument in Asia Minor. Its antiquity is demonstrated by the fact that the plow, as represented on Egyptian monuments more than 3000 years B. C., shows a slight improvement over it. The Romans are also known to have used wooden plows of a very primitive type, with an improvement in the days of the Tarquins of a handle, which allowed the plowman to more easily hold the point in the ground. Chinese historians say that the Emperor Shen Neng, who ascended the throne of China 2737 B.C., "first fashioned timber into plows and taught the people the art of husbandry."

The records of the past fail to show us when and where metal points or shares were first used. Several prophetic allusions are made in the Old Testament to the time when warriors would "beat their swords into plow shares," and it is known that ancient Egyptians and Assyrians had plows that were pointed or edged with copper and iron, but the time when metal was first used cannot be even guessed.

In a later period, probably in the time of Cincinnatus and Cato, the Romans used a plow that was quite different from the older patterns common in various countries. J. Stanton Gould, in his report to the New York Agricultural Society in 1856, says that this plow "will be found to exactly agree with the description of the implement given by Virgil in the Georgics. The sole of the plow has two rectangular pieces of wood fixed to it on each side, forming an acute angle with it, in which the teeth (*dentalia*) are inserted. This exactly answers the description of Virgil: '*Duplici aptantur dentalia dorso*' (the teeth are fitted to the double back). These project

obliquely upward, and perform the office of a mouldboard. The share was of metal."

The plows of ancient times seem, however, to have been built only for the purpose of breaking and stirring the soil, the bottom having been invariably a simple wedge, with no power to turn a furrow. It is true that plows may have been made with one side straight like a modern landside, and with the other side extending out to push the loosened soil over and thus leave something like a furrow, but "no one had as yet grasped the idea of combining two wedges in the same implement, nor had they any idea of the curves by which this could be effected." The practical combination of share and mouldboard remained to be discovered.

Gould refers to a wheeled plow used in France for centuries, no one knows just how long, which seems to be the first feeble attempt to realize the idea of a mouldboard. Its model has been handed down unchanged for centuries. It had the principle of the twisted wedge, "raising up the earth first and then twisting it to the right. It is furnished with two wheels to keep it steady in the furrow, and a coulter of the modern form. It is a rude affair when compared with our modern implements, but it shows real genius in its author."

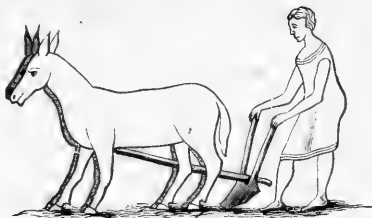
It is well to note here that this is not the first use of either the wheel or coulter on a plow. Plows having the beams supported by two wheels, some of them approaching in form the two-wheeled sulky so popular a few years ago, were made by the Greeks 2000 years ago. The coulter was certainly known in the time of William the Conqueror, in the eleventh century, in England, if not earlier, for we read that at that time plows with their beams supported on wheels were very common, one of them being described as follows: "It was drawn by four oxen and fastened to them by ropes made of twisted willows, and sometimes by the skins of whales. It consists of a simple wooden wedge, covered with straps of iron, one side being placed parallel to the line of the plow's direction, the other sweeping over to the left hand, cleaning it from its own path and leaving an unobstructed furrow for the next slice. A coulter, not unlike those now in use, is inserted in the beam, and a wheel is placed in front to regulate the depth."

Thus far, however, it would seem that no real inventor had appeared to contribute to the development of the plow, and even as late as fifty years ago in this country the usual method of plow-making was for the farmer to purchase the wood part of his plow from a "plow-wright (or often from the jack-of-all-trades wagon maker) and have it "ironed" by the local blacksmith, although sometimes the wagon maker bought the irons and "stocked" them.

The first English patent granted on a plow was to Joseph Foljambe, of Yorkshire, in 1720, he having invented a number of improvements on a crude style of plow, which had been brought from Holland. The bottom of Foljambe's plow was of wood, with a sheet-iron covering on the wearing parts and a point of iron plate. The coulter was, of course, made of iron. The point was conical in form and the furrow was raised by it and then turned over by the mouldboard. The handles and beam were better proportioned than any that had been in use previously, and the first clevis



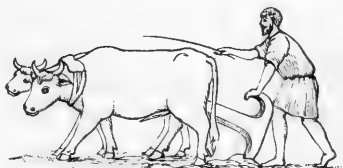
THE OLDEST PLOW, USED IN ANCIENT ASIA.



ANCIENT EGYPTIAN PLOW.



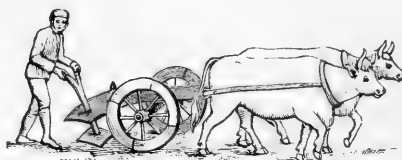
EGYPTIAN PLOWING AND SEEDING.



ANCIENT ROMAN PLOW.



ANOTHER STYLE. ANCIENT ROMAN PLOW.



OLD ENGLISH PLOW.



ANCIENT EAST INDIAN PLOW.



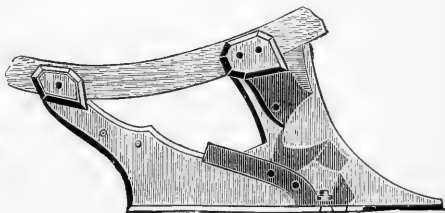
THE CASCHROM, HEBRIDES ISLANDS.



ANCIENT SAXON PLOW.



JAMES SMALL'S EAST LOTHIAN PLOW.



FRAME OF THE EAST LOTHIAN PLOW

that is known to have been used on a plow was fitted to the beam. But this plow, although it was superior to anything then known, did not come into general use until James Small established his factory at Black Alder Mount, Scotland, in 1763, and began to manufacture and sell plows on what was then a large scale. In time he made many improvements, and the plow finally assumed the style of the East Lothian, which gave general form and feature to all the common British plows since. The beam and handles were of wrought iron, the body frame and mould-board were cast, and the share was of wrought iron. Robert Ransome, of Ipswich, England, obtained a patent in 1785 for making the share of cast-iron, and in 1803 for case-hardening or chilling the share, and Thomas Brown, of Alnwick, England, was engaged at the opening of this century in building plows of improved form and construction still more approaching the modern implement. The seed sown by Ransome in 1785 took root, and produced a manufacturing establishment, which to this day is one of the largest in England, having followed the industry through all the changes of a century. Howard, beginning about 1840, established a factory which has also continued to the present day, having contributed, from time to time, improvements and changes in patterns as demanded by the progress of invention or the change in "fashion."

In America, progress in the development of the plow was slow during colonial times, owing to the narrow policy of England in discouraging or prohibiting altogether the establishment of factories. The manner of making a plow a century ago was remarkably crude, judged by modern standards. In the language of Gould: "A winding tree was cut down, and a mouldboard hewed from it, with the grain of the timber running as nearly along its shape as it could well be obtained. On to this mouldboard, to prevent its wearing out too rapidly, were nailed the blade of an old hoe, or thin straps of iron or wornout horseshoes. The landside was of wood, its base and sides shod with thin plates of iron. The share was of iron, with a hardened steel point. The coulter was tolerably well made of iron, steel edged, and locked into the share nearly as it does in the improved lock coulter of the present day (1856). The beam was usually a straight stick; the handles, like the mouldboard, split from the crooked trunk of a tree, or as often cut from its branches, the crooked roots of the white ash being the favorite timber for plow handles in the northern states. The beam was set at any pitch fancy might dictate, with the handles fastened on almost at right angles with it, thus leaving the plowman little control over his implement, which did its work in a very slow and most imperfect manner." It must be remembered, however, that in colonial times the land under cultivation was very largely "new ground," or land recently cleared of timber, with a porous soil which was easily penetrated and stirred up. It had neither the stickiness nor tendency to bake of clay land which has long been under cultivation, nor the impenetrable network of leathery grass roots which made the breaking of virgin prairie soil so difficult. And besides, farming was conducted on a far smaller scale then, for the cities being small and few in number, the market for farm products was limited, and the average farmer contented himself with growing enough for his family, with a

small surplus for purchasing the very few articles of commerce indulged in at that early day.

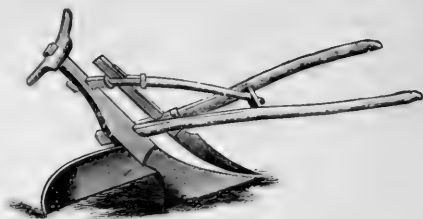
Thomas Jefferson, the renowned statesman, was the first to bring theoretical knowledge to the design and the construction of the mouldboard. Writing in 1788, he referred to the curves which should characterize a mouldboard, and said: "The offices of the mouldboard are to receive the sod after the share has cut under it, to raise it gradually and to recover it. The fore end of it should, therefore, be horizontal, to enter the sod, and the hind end perpendicular, to throw it over; the intermediate surface changing gradually from the horizontal to perpendicular. It should be as wide as the furrow, and of a length suited to the construction of the plow." While Jefferson succeeded very well in using the experimental plows which he made, the time was not yet ripe for the general adoption of his ideas, and his work was lost for a generation, until it was taken up and improved upon by Wood and later inventors.

The first letters patent granted in America, on a plow, was in 1797, to Chas. Newbold, a farmer of Burlington, N. J. His specification was as follows: "The subscriber, Chas. Newbold, of Burlington county, New Jersey, has invented an improvement in the art of plow making, as follows, viz.: The plow to be (excepting the handles and beam) of solid cast iron, consisting of a bar, sheath and mouldplate. The sheath serves a double purpose of coulter and sheath, and the mouldplate serves for share and mouldboard, that is, to cut and turn the furrow. The forms to be varied, retaining the same general principles, to meet the various uses, as well as inclinations of those who use them." Although Newbold's plow worked well, far better than those in general use at that time, the farmers rejected it, on the plea that the cast iron "poisoned the land," and stimulated the growth of weeds, and after spending \$30,000 in trying to get it introduced, the inventor gave up the task in despair. During the twenty years following Newbold's invention, a number of patents on plows were issued, but nothing valuable was contributed to the art of plow building, and the rude "bull" plow with its wooden mouldboard still ruled the realm.

— Jethro Wood's invention, patented September 1, 1819, ushered in a new era in the history of the plow, the era of manufacturing, as distinguished from the era of building in small quantities by blacksmiths or "plow wrights." "In Wood's plow, cast iron was substituted for the wooden mouldboard, landside and standard, and a cast iron point or share for the old wrought, steel tipped share." But the most important part of Wood's invention was the *interchangeability of parts*. This it was that established the era of manufacturing, by making it possible for the farmer to replace a wornout or broken casting with a new one from the factory. Wood also sought to form his mouldboard on scientific principles, so that the pressure of the turning furrow would be evenly distributed on its surface, and thus avoid wearing it in spots. After many ups and downs, Wood succeeded in reducing every point of his invention to practice, and its merits soon won for it wide recognition, followed by a general demand from the farmers for the new plow; and then began the struggle which finally drove the noble inventor to his grave. A demand once created for the invention, others be-



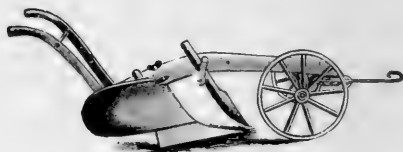
CORSICAN PLOW.



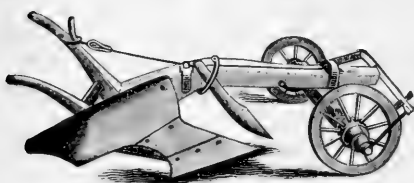
NORTH RUSSIAN PLOW "KOSOCLIA"



SICILIAN PLOW.



PLOW FROM SOUTH RUSSIA.



PLOW OF CENTRAL RUSSIA.



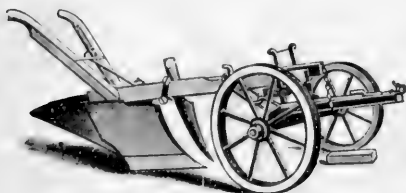
PLOW FROM CREMONA, ITALY.



PLOW, DRAWN BY OXEN, FROM SARDINIA.



ITALIAN PLOW FROM LOMBARDY PLAINS.



FRENCH PLOW.



IMPROVED FLEMISH PLOW.

gan to manufacture it—in wanton disregard of the inventor's rights, acquired by his work of a lifetime, and the expenditure of a fortune in his experiments—and in his efforts to enforce his rights in the courts his little remaining property was spent, and his children, after his death in 1834, were equally unsuccessful in securing reparation, although congress had, in 1833, extended the life of his patent fourteen years. In the words of Wm. H. Seward, secretary of state under Lincoln: "No citizen of the United States has conferred greater economical benefits on his country than Jethro Wood—none of her benefactors have been more inadequately rewarded."

Manufacturers throughout the country having copied Wood's invention with alacrity, it was not long until cast iron plows were in general use, and for a generation or longer but little was done to improve his model, further than to make changes in detail, adapting it to the needs of different parts of the country.

Joel Nourse was one of the noted plowmen of the generation succeeding Wood. He first started at Shrewsbury, Mass., but afterwards removed to Worcester, and in 1842, perfected the famous Eagle series, plows with a longer mouldboard than Wood's, and with a greater turn, breaking the furrow more thoroughly. The sales in the forties of Nourse's firm, (Ruggles, Nourse, Mason & Co.), were said to have reached 25,000 and 30,000 plows per year.

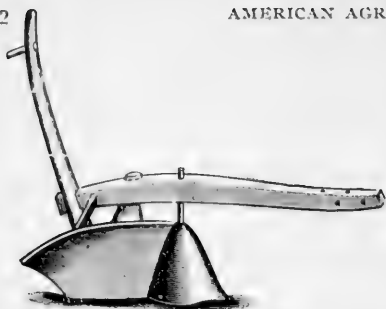
THE INVENTION OF THE CHILLED PLOW.

There remains to be noticed an important step in the perfection of the plows in use throughout the eastern states. Efforts to harden the wearing parts, and thus make them more durable, began almost with the first use of cast plows, but the chilling process was so little understood, that for more than half a century no one could master it. Credit for making the chilled plow a practical success is due to James Oliver, who began experiments soon after establishing his plow shop or factory at South Bend, Ind., in 1853.

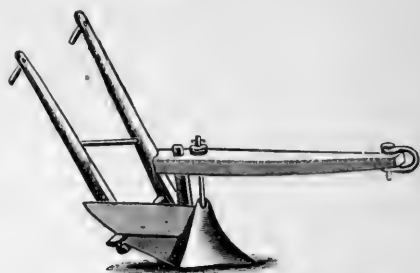
It is a fact worthy of note, that when cast or "grey iron" plows first came into use, made after the patterns of Wood, Nourse and others, no complaints were heard in regard to scouring. But as the country grew older, and the soil, by repeated working, became dense and sticky, it was found that cast iron scoured with difficulty, or not at all. Hence the great demand that was heard among the next generation for a new kind of plow that would respond to the changed requirements. This demand was filled by the invention of the chilled plow, as was also the demand for a mouldboard that would withstand more efficiently the wearing of gravelly or sandy soil.

It was this general and unremitting demand that led Mr. Oliver to persevere in his efforts to produce a perfect chilled plow, in the face of as great obstacles as ever embarrassed an inventor. For years it seemed as though the problem would not be solved, so long did it require to produce a chilled mouldboard that would meet the varying requirements of the farmers, but success dawned at last, and with it a new epoch in agriculture.

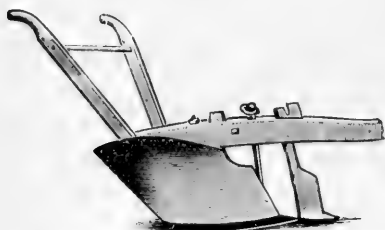
Thomas Jefferson had formulated the design of an ideal mouldboard, and Jethro Wood had done much to realize this ideal, but of the cast plows in use when Mr. Oliver began his experiments, there were few that had



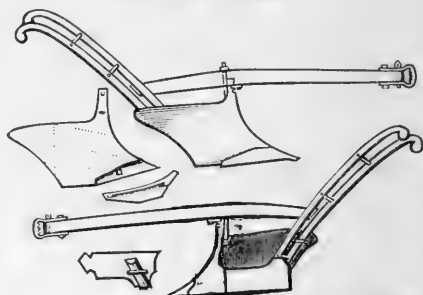
WOODEN MOULDBOARD DUTCH PLOW FROM
ALBANY COUNTY, N. Y., 100 YEARS OLD.



WOODEN MOULDBOARD PLOW FROM PENNSYLVANIA, 100 YEARS OLD.



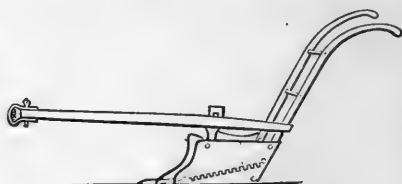
WOODEN MOULDBOARD HORIZONTAL SHARE
PLOW, OF A CENTURY AGO



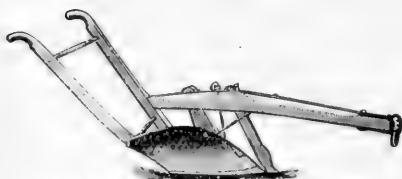
JETHRO WOOD'S PLOW, PATENTED SEPT. 1, 1819.



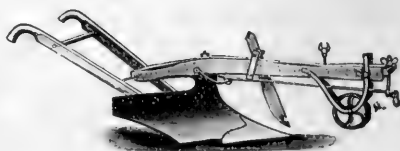
CHAS. NEWBOLD'S PLOW, PATENTED 1797.
FIRST AMERICAN CASTIRON PLOW.



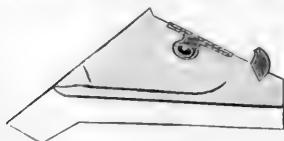
ZADOK HARRIS' PLOW, 1819.



SIR JOSHUA GIBBS STEEL PLOW, 1838.



NOURSE'S EAGLE PLOW, BUILT IN THE "FORTIES"



OLIVER'S CHILLED EDGE SHARE, PATENTED
JULY 29, 1879.



OLIVER'S PATENT NOV. 18, 1873.

mouldboards even approximating the best form by which lightness of draft, even distribution of the pressure of the soil over the wearing surface, and a properly laid furrow might be secured.

Two fundamental defects had hitherto stood in the way of a successful chilled mouldboard. One was the frequency of soft spots or blow holes in the casting, making it short lived, and the other was the extreme brittleness of chilled metal, and the risk of breakage in a mouldboard of convenient weight and thickness. A remedy for the first was finally discovered in using hot water under certain conditions in the chills, and a way was soon afterwards found for removing the brittleness. By a peculiar annealing process it was made possible to toughen the metal without softening it, and so to give it the strength that would enable it to endure the hard usage of general purpose work on a million farms. With this discovery the last barrier in the way of a successful chilled plow was removed.

In their general construction the cast and chilled plows of the east have been so different that it will be proper to follow them a little farther before taking up steel plows. The two classes may thus be kept distinct. Apparently the first patent covering a practical device for adjusting the beam laterally in a plow was issued to E. Ball, of Canton, Ohio, more famous as a reaper inventor, the patent bearing date of March 23, 1852. It showed a standard with a double head, with the beam held to it by two bolts in such a way that it could be adjusted both laterally and vertically. The beam was cut off at the rear of the standard.

R. A. Graham's patent, Oct. 4, 1853, showed a lug on the landside handle to which the heel of the beam was attached, a peculiarly arranged set screw giving the beam a lateral adjustment. This patent also claimed a screw-bolt in the bottom of the handles, arranged as an adjustable brace for the mouldboard. Still another method of shifting a beam laterally was shown in the patent of A. W. Stoker, Sept. 11, 1866, in which the handle brace was a rod extending through the heel of the beam, a portion of the rod being threaded to permit of holding the beam in position with nuts.

The slotted handle brace now in general use on plows that are adapted to either two or three horses, was patented by James Oliver, Feb. 21, 1871. In this patent Mr. Oliver covered also a share with a fin cast upon it extending upward from the landside edge of the point so as to cut the soil or sod. June 18, 1872, the same inventor patented his peculiar standard by which the beam is brought more directly over the line of draft, the shin extending to the side past the landside edge of the beam. This patent also covered the peculiar Oliver wheel for a wood beam plow, one arm of the standard being slotted to permit a vertical adjustment, and the other arm flattened on its end and fitted under the beam, where it is held by a hook in a way to permit alignment of the wheel when the beam is shifted. In his patent of Nov. 18, 1873, Mr. Oliver shows a share with a coulter or shin cast as a part of it, to be seated against the front edge of the mouldboard, and also the sloping landside, a feature that has ever since distinguished his plows in the trade. A later patent, issued July 29, 1879, and several succeeding it, covered for Mr. Oliver the process of chilling the nose and cutting edge of a share.

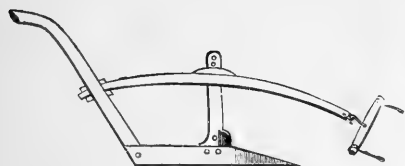
The Patent Office records show many efforts to produce a cast share with a slip or reversible nose, the names of M. M. Bowers and James Oliver appearing oftener than others, and their inventions having a more practical appearance. Mr. Bowers' first patent appears in 1875, and his last in 1880. An important patent was also issued to Mr. Oliver May 8, 1877, for a jointer or coulter holder. It covered a holder rigidly secured to the standard of the plow, and having a slotted plate fitting the under side of the beam, to which it was held, as well as a slotted arm extending downward, to which the jointer or hanging coulter blade is attached.

STEEL WALKING PLOWS.

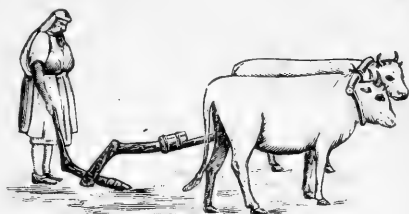
When hardy emigrants from the Old World landed upon our eastern shores to establish settlements, they found that in the land of their dreams, "flowing with milk and honey," the advantages of free farms were largely offset by the disadvantages of pioneer life, of clearing away the forest, and preparing the soil for the growth of their crops. They had new proof of the fact that the treasures of the soil can only be unlocked by patient and persistent application. The experience of settlers east of the Alleghenies had its counterpart in the pioneer work of those who settled in the vast prairie region of the Mississippi valley, extending a thousand miles westward from Ohio. Where the ax and the "grub hoe" had been needed to subdue the eastern land, the prairie breaking plow, with a share as sharp as the woodman's ax, was required to penetrate the turf of a thousand years' growth and uncover the inexhaustible soil that lay shielded beneath the hard, matted roots of the prairie grasses and weeds. Never in history had such a problem confronted the land-seeking emigrant; but, with ready ingenuity, he forged with blacksmith's tools a new kind of plow to meet the new requirements. The old principles of a beam, handles, a mouldboard, standard and share were all right, but the mouldboard must be made with a long, easy curve, and the share with an edge of the finest steel. In late years, probably early in the "forties," a few curving rods were attached to the share in place of a mouldboard. The plow was made of exceptional strength, for it was the rule to use three to six yokes of oxen in breaking.

With the problem of breaking overcome, it might have been expected that the soil would become tractable and obedient to the touch of its master, but yet another obstacle was to be surmounted. The old wooden plows, and those of cast iron that were coming in from the east, or of "boiler plate" that were made by local blacksmiths, would not scour in the light vegetable mould after it had been stirred up by cultivation during several seasons. Various remedies were tried, but without avail, until it was discovered that a high grade of steel would clean itself and do satisfactory work. Who it was that made this discovery it would be difficult to determine, but the first steel plow of which there is any record was made in 1833 in Chicago in the woods near where the Illinois Central station at Twelfth street now stands.

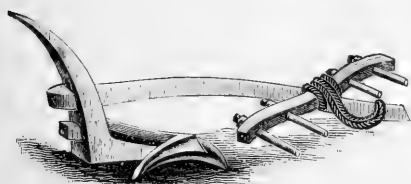
The maker of this plow was John Lane, whose son, the inventor of soft center plow steel, was a witness of the incident, and yet lives in Chicago to tell the interesting story. A rude forge of logs had been built by Mr. Lane, who was a blacksmith, and to a tree that stood by it a bellows was hung.



NATIVE PLOW, PHILIPPINE ISLANDS.



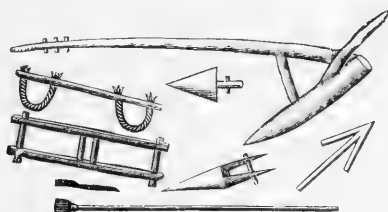
PERSIAN PLOW.



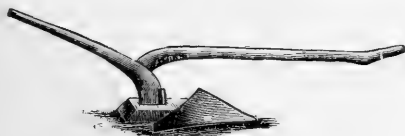
ANOTHER STYLE, PHILIPPINE ISLANDS.



MEXICAN PLOW.



HEBREW PLOW, BIBLE TIMES.



JAVANESE PLOW



JAPANESE PLOW.



JAPANESE HAND PLOW.



MEXICAN PLOW.

An old saw, probably a worn out "crosscut," had been cut and deprived of its teeth, and three lengths of it were used to make a mouldboard of the requisite width, another piece forming the share and an "anchor wing" of iron, the three-cornered shin piece shown in illustration.

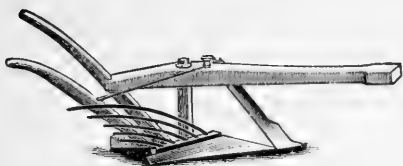
For several years it was impossible to obtain anything but saws from which to make a plow, and old ones were gathered up and used until the supply was exhausted, and new ones had to be purchased. In 1836 or 1837 plow makers like Lane were able to obtain from Pittsburg saw blanks or plates, seven or eight inches wide, in which the teeth had not been cut, two widths being sufficient for a mouldboard. Two or three years later, as nearly as the younger Lane can remember, a special width of steel could be had from Pittsburgh, rolled twelve inches wide, and this gave quite a boom to the infant industry.

It was a plow with a mouldboard made of old saws that John Deere, then a blacksmith, built in 1837, after he had come west and settled in Grand Detour, Ill. The success of the first two which he made led him to build a considerable number, for which he found a ready sale. This again inspired him to higher efforts, and he ordered from abroad the steel which could not be obtained in this country in the quantity or quality he desired, and went still further in his improvements. "The first slab of plow steel ever rolled in the United States was rolled by Wm. Woods at the steel works of Jones & Quigg and shipped to John Deere in Moline, Ill.," says James M. Swank, in his "History of Iron and Steel In All Ages." Mr. Deere removed to Moline from Grand Detour in 1847 and founded the business which is now carried on, perpetuating his name. His partner at Grand Detour, Major Andrus, continued at that place until later years.

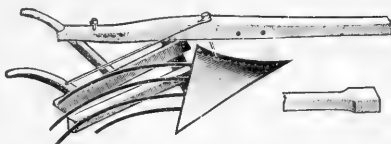
Wm. Parlin, another pioneer in the days when the Illinois prairies were settled and broken, worked in much the same way, beginning in 1842, and laid the foundation for what is claimed to be the oldest permanent steel plow factory in the west. Many other names could be mentioned of men, who, with the blacksmith's hammer and sledge, brought forth in limited numbers what was then the most important of all agricultural implements.

But few patents have been issued affecting the form or general appearance of the steel plow, which has always been made on simpler lines than the chilled plow.

The manufacture of steel for plows used on the prairies of the west was revolutionized in 1868, by the invention of "soft center" steel for mouldboards, shares and landsides. For a time during the infant years of the industry plows were made from a high grade of saw steel, but before long cheaper material was substituted, with the result that plows made of it would not scour in all kinds of soil. Case-hardened German steel was then tried, but it was not generally satisfactory, chiefly because of the difficulty in tempering it uniformly. In 1862 an invention was patented that in some measure paved the way for the introduction of "soft center" steel, but it did not come into general favor, although it is still used successfully by two well-known plow manufacturers. It was covered by the patent of Wm. Morrison, and consisted in the use of a cast steel plate for the face of a mouldboard, share or landside, welded upon and strengthened by a backing



PRAIRIE BREAKING PLOW OF 50 YEARS AGO.



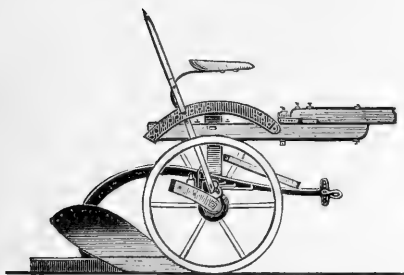
ANOTHER STYLE PRAIRIE BREAKING PLOW.



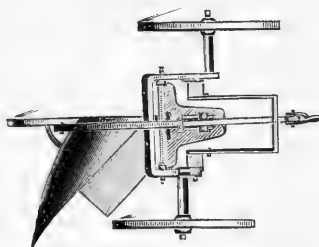
THE FIRST STEEL PLOW, 1833.



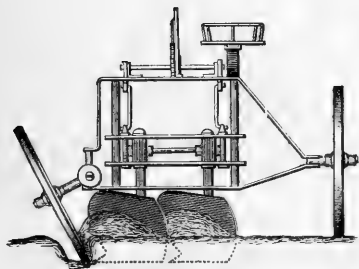
JOHN LANE'S PATENT, 1868, "SOFT CENTER" STEEL.



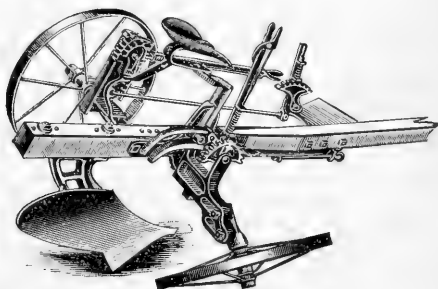
GILPIN MOORE, JUNE 29, 1875.



GILPIN MOORE'S PATENT, JUNE 29, 1875.



W. L. CASADAY'S PATENT, MAY 2, 1876.



W. L. CASADAY'S PATENT, SEPT. 6, 1881.

plate of soft iron. The great defect in it, which prevented its general introduction, was its tendency to warp in tempering, which could only be overcome by a tedious and unsatisfactory method of holding it in clamps. The iron and steel would not expand and contract together.

John Lane, above referred to, some time prior to applying for his patent, which was issued Sept. 15, 1868, conceived the idea of making a plate of three layers, two outer plates of steel, with a central one of soft iron or steel. When made in this way a mouldboard or other shape would not warp enough to injure the scouring or turning qualities of the plow, as the one layer of steel balanced the other in heating and tempering, and the soft plate in the middle made the combination stronger than any form of steel that had ever been used.

The importance of this invention can hardly be estimated. On many kinds of prairie soil plowing was done with great difficulty, and in some sections it could not be done at all with the old style plows, except under favorable conditions. The new kind of steel was like oil upon troubled waters, and proved itself worth millions annually to the farmers of the west. Its inventor was content with a royalty of about 3 cents on a plow, yet this amounted to a sum that would have made Jethro Wood one of the wealthiest men of his day.

It was of the steel plows that turn the prairies of the west that Mr. Marsh wrote in his beautiful "plow sentiment" in 1885 as follows: "The young farmer, if possessed of any spirit, as he guides a well set, keen cutting American plow through the ground behind a spanking team, his well made implement answering promptly to his touch, shaving the roots, and covering all with the rushing furrow as it ripples from the polished mouldboard, feels an exhilarating interest in his work, akin to that of the sailor who plows the waves with a light, trim vessel under a spanking breeze. There is the same sort of mastery over the elements and a like freedom of action in governing them. In my observation of foreign farming it seemed to me that the marked superiority of American farmers, in spirit and intelligence, was largely due to the finish and capacity of the agricultural implements in use in this country.

"American inventors and manufacturers have done much by providing such superior tools, to educate and elevate our operating classes; while on the other hand, such intelligence demands from manufacturers a continuance of their best efforts, and the combined result is manifest in the fact that as a working people we are infinitely in advance of all others. We labor with zest and a masterful spirit because our tools are in accord and give us perfect command over the work in hand. What a contrast between our plows and the thing so called in Russia, for instance, and what a contrast also between the respective operators. Like plow, like man. On the one side are brightness, keenness and adaptability; on the other coarseness, clumsiness and stolidity.

"Americans whittle because they carry finely finished and keen cutting knives, and it is a pleasure to use them. The same pleasure exists in the use of our machinery, generally. Not so on the other side; their implements excite no impulse to operate them nor pleasure in their operation.

If your knife was but a piece of hoop iron edged, you would have no impulse to whittle. A European peasant's plow beside one of ours affords a like comparison. It does seem as if the general diffusion of intelligence throughout the world, by paper, steam and electricity, would ere long awaken the foreign tiller of the soil, and penetrate even his stolid soul with an ambition for better things than what have come down to him scarcely improved for a thousand years and he ought to begin the new life with an American plow."

SULKY AND GANG PLOWS.

Although sulky riding plows are now eminently practical implements and are in general use throughout the west, a brief period of thirty years would cover their development. Twenty years of this time were taken up by the invention and manufacture of various styles of the old two-wheel sulky, the three-wheel plows, now so popular, having been made practical for general introduction within the past ten years.

So many patents were granted during the reign of the old sulky that they present the aspect of a pathless wilderness, one that the author has no intention of exploring. It may be in order, however, to notice briefly a few of the pioneer patents on wheel plows or those on sulkies which became popular. The first patent that appears in this class was granted to H. Brown, March 9, 1844, and covers an arrangement of plow bases in a gang. The next, issued to E. Goldthwait, Nov. 26, 1851, shows a plow with two wheels supporting the forward end of the beam, the plow being constructed substantially like a wood beam walking plow. A patent was issued to C. R. Brinckerhoff, Oct. 11, 1853, on a plow which was almost the same in general form, though differing in details of construction and adjustment. Several patents were granted on gangs prior to that of M. Turley, Dec. 9, 1856, which shows a sulky with one base. During the years following patents were issued at frequent intervals to inventors in various parts of the country, covering the arrangement and adjustment of sulky and gang plows.

One of the first sulky plows to be made practical for introduction into general use was the Davenport, based on patents issued to F. S. Davenport, Feb. 9, 1864, for a gang plow. Robert Newton, of Jerseyville, Ill., in 1864 converted one of Davenport's gangs into a three-horse plow, with one sixteen-inch base, a three-horse evener and rolling coulter, and used it successfully, making many improvements which were found necessary, such as to change the position of the tongue, putting it between the land horses. Mr. Newton met with many discouragements, but persevered and was able to sell twenty-six sulky plows in 1865 in the state of Illinois. From this small beginning he saw the trade grow until in one year 36,000 plows of this type were sold by one house, he having captured in the meantime ninety-one out of 107 field-trial awards. By 1868 there were several practical sulkies in the field, and an important trial was held at Des Moines in that year. Many other trials were held in the years following, and at St. Louis, in 1873, there were sixteen sulky plows entered in competition, more than had ever before been brought together.

January 19, 1875, a patent was granted to Gilpin Moore, on a sulky that became widely known as manufactured at Moline by Deere & Company.

May 2, 1876, a patent was granted to W. L. Casaday, reissued Nov. 13, 1877, on the famous Casaday sulky, made by the Oliver Chilled Plow Works, which was the first to do away with the landside and use a wheel set at an angle against the furrow to support the plow. Other important patents were granted to Casaday in the years following on adjustments for this plow. In 1884 the first of the three-wheel plows was introduced in the trade by the Moline Plow Company, based on patents that had been issued to G. W. Hunt. The ultimate success of this type of plow inspired inventors everywhere to activity in the new field, and many improvements and variations have been recorded in the Patent Office in the intervening years. To enter into a description of all of them would be impossible, and it is too early in their development for the evolution of the trade to show what principles are destined to triumph and become the standard.

For the past forty years inventors have worked on the problem of steam plowing. The favorite plan in England has been to draw a gang of plows back and forth across the field by a cable driven by an engine at one side, or often by two engines, one on each side of the plot. Many of these outfits went into use, and at least one or two were imported into this country and used for a time. The plan proved a clumsy one, however, and has been almost entirely abandoned abroad.

In this country the popular plan has been to draw a gang of plows behind a traction engine. In some cases a modified form of threshing engine has been used, of sixteen or twenty-horse power or larger. Excellent results have been obtained, and many outfits of this type are now in use.

During the past ten years the needs of wheat ranches in California and elsewhere have developed a special form of engine for plowing, harvesting and similar work. As built by Jacob Price at the J. I. Case Works in Racine, and by the Benicia Agricultural Works, Daniel Best and others in California, this engine has assumed a tricycle form, the weight of the boiler and engine resting on two very high, wide tread wheels, with a third wheel in front of castor type for easy steering. A high pressure, force draft boiler is used, and small, high-speed engines, developing forty to eighty-horse power, according to the size of the outfit. Such engines are in general use on large farms in the west, drawing twelve, fifteen and sometimes eighteen twelve-inch plows, and turning over twenty-five to fifty acres per day.

CHAPTER II.

Harrows.

ALTHOUGH the harrow is of far less antiquity than the plow, it is a more difficult matter to trace its origin and development. The first harrow used by man was undoubtedly nothing more than the branch of a tree, and it is equally probable that the next stage of development was a crude wooden frame with wooden teeth, or possibly a forked timber with a piece extending across the rear from one prong to the other. A peculiar form of A frame harrow, shown in our illustration, was used by the ancient Romans, who also had a kind of smoothing harrow. Pliny says: "After seed is put in the ground harrows with long teeth are drawn over it."

In the Bible it is said of King David, about 1033 B. C., in describing his treatment of the men of Rabbah, that "he cut them with saws and toothed harrows of iron and with axes." Other references are made in the Bible to harrows as a means of torture, but no mention is found of their use in agriculture. We may infer, however, that they were generally used for that purpose, and that their adaptability as a means of torture in those days of cruelty and bloodthirstiness was only incidental.

The Japanese have used from time immemorial disk harrows, like that shown in our illustration, which, it will be observed, has smoothing blades or teeth running behind the disks. A roller with teeth is also of unknown antiquity in Japan, and both it and the disk harrow are in common use to-day in that country.

Harrows may be properly divided into three general classes; spike tooth, disk and spring tooth. The first two, as we have just seen, are of remote antiquity, the spike tooth being probably the older, as wooden teeth would be naturally used before disks were invented. The spring tooth is an invention of the past generation. The spike tooth harrow of the early settlers in the west was so simple in construction that the frame was usually home-made or made to order at the village wagon-maker's, the teeth being forged of iron by the village blacksmith. Aside from changes in frame and manner of hitching, the only improvement of which this harrow was susceptible was giving the point of the teeth a backward pitch to thus make them more effective in smoothing the surface and crushing clods. With the cheapening of iron and steel, however, came the practicability of making the frame of iron and the teeth of steel. Then a lever to change in an instant the pitch of the teeth was invented by an Iowa man early in the "seventies" and the spike tooth harrow as made by plow manufacturers and others and largely sold throughout the west, was perfected.

— The first patent in the United States for a revolving disk for pulverizing the soil was granted Aug. 7, 1847, to G. Page, and showed a single disk used

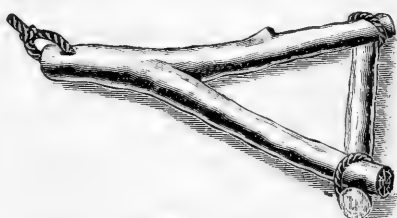
as a side part of a peculiar form of plow. For the arrangement of disks in a gang, a patent was issued June 27, 1854, to H. M. Johnson, this invention seeming to lay the foundation for the modern disk harrow, although in a previous patent in 1846, disks were shown as an attachment to a seeder, following behind to pulverize the ground and cover the seed, with a rake attachment bringing up the rear. S. G. Randall patented in 1859 a combination of a broadcast seeder and two gangs of disks set at an angle. With this invention as a basis on which to build, our inventors and manufacturers went on from step to step, making improvements and changes, all of which have resulted in the various forms of disk harrows now on the market. The manufacture of such harrows began in the "seventies" in New York, and about 1880 prominent manufacturers in the west became interested in the trade, which has developed largely in their hands.

The spring tooth, as generally used in harrows of this class, was invented by David L. Garver, of Hart, Mich., and patented in 1869. For eight years the inventor made unsuccessful efforts to introduce his harrow, only making a few. At this time D. C. Reed, of Kalamazoo, became interested in the harrow, and endeavored to establish the manufacture of it. Finding Garver's invention incomplete, he improved it by the addition of an adjustable clip for holding the teeth in any position desired, which he patented in 1877. This improvement made the new implement a successful one, and the demand for it became general among the farmers, especially in the eastern and central states. Many inventors sought fame in the new field, and patents on new devices and variations of old ones multiplied, all being subordinate during its life to the Garver patent on the spring tooth. D. C. & H. C. Reed & Co., of Kalamazoo, were the first to begin manufacturing in the west, followed a year later by Chase, Taylor & Co., and by others. In the east G. B. Olin & Co. at Canandaigua, N. Y., acquired an interest in the Garver patent and were pioneers in manufacturing. As new manufacturers came into the field patent litigation increased, and by the fall of 1890 matters had fallen into so much of a tangle that it was deemed best by leading houses to consolidate their interests in patents, which numbered several hundred, into a corporation to be known as the National Harrow Co. This was accomplished, and the company was made trustee or owner of all the patents, the different manufacturers, originally fourteen or fifteen in number, taking licenses to manufacture. In time others were taken into the fold, and at present the licensees number about twenty-five. Within the past year a consolidation of manufacturing interests has been effected, several large houses turning over their business to a new company, known as the Standard Harrow Co.

Of late years several new types of harrows have been brought before the trade, notably an invention of La Dow, a spading harrow, manufactured at Brockport, N. Y., by D. S. Morgan & Co., the old reaper house, and the Clark "cutaway" harrow, made at Higganum, Conn.



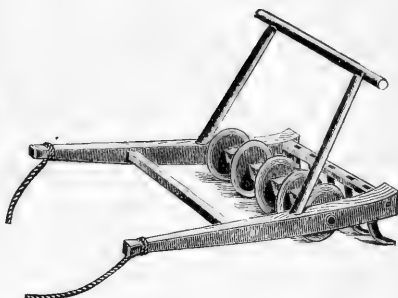
PRIMITIVE BRUSH HARROW.



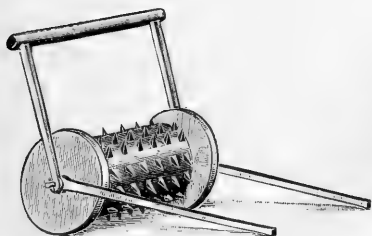
FIRST IMPROVEMENT, CROSS BAR HARROW.



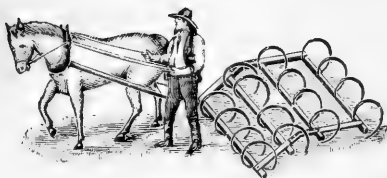
ROMAN SPIKE TOOTH HARROW.



JAPANESE DISK HARROW.



JAPANESE TOOTHED ROLLER.



GARVER SPRING TOOTH HARROW, 1869.

CHAPTER III.

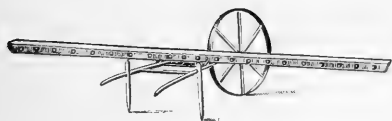
Grain Drills.

UNDOUBTEDLY the first method of putting seed in the ground by primitive man was to make holes with his stag's horn or crooked stick and drop in the seed, covering it afterwards. Broadcast seeding probably originated in the valley of the Nile, where, after the water had subsided, a farmer could sow his seed and drive sheep over the ground or go over it with a brush harrow or plow. The first trace of a seeding machine that is found in history is an Assyrian drill used many centuries before Christ, a reproduction of it being found on the Aberdeen "black stone," of the time of Esarhaddon, 680 B. C. "It was a rude implement, having a mouldboard made from a round stick of toughened wood, with a tongue and handles attached. In the rear of the plow point was attached a bowl-shaped hopper, supported upon a hollow standard, through which seed passed to the furrow, and was covered by the turned furrow falling back upon it." The Chinese have a kind of wheelbarrow seeder with hollow teeth which draws furrows and drops the seed, and it is claimed that this implement has been used for ages.

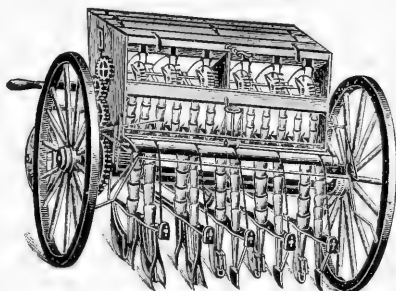
It is said that in Italy about the year 1600 A. D., a seeder running on two wheels and supporting a seed-box on its axle, was used. It was "mounted on two wheels, the axle passing through the seed-box, on the bottom of which was a series of holes opening into an equal number of metal tubes or funnels, through which the seed was conducted to the ground. The fronts of the tubes, at their lower ends, were shaped somewhat like plowshares, and were designed to make small furrows into which the seed dropped."

Several efforts were made during the sixteenth century by English inventors to perfect a seeding machine, and their machines may have worked well in the hands of the inventors, but were soon lost sight of and forgotten. One machine by an unknown inventor on the continent was manufactured and patented about 1664, and in 1669 John Evelyn presented one to the Philosophical Society of London, and it is even claimed an agent was appointed in London for its sale. The machine was attached to the "stilts" of a plow, behind, and consisted of a seed-box having a cylinder furnished with wheels to distribute the seed, which was dropped regularly in the furrow.

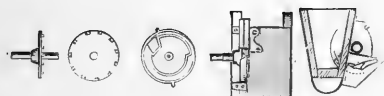
The greatest contribution to the early development of grain drills was made by Jethro Tull in the eighteenth century. In 1731, in a work which he published, entitled, "Horse-hoeing Husbandry," he argued that grain and seed should not be sown broadcast, but should be planted in rows or drills so as to admit of hoeing by horse power with proper implements. His first drill was constructed so as to sow wheat or turnips, three rows at a time.



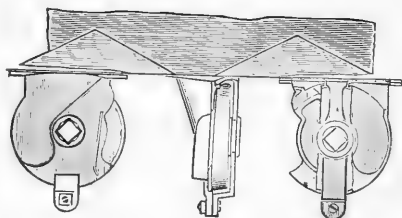
ENGLISH WHEELBARROW SEEDER, 1820.



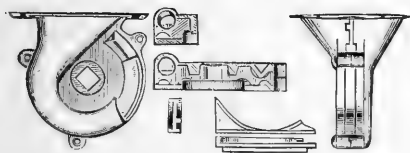
COOKE'S GRAIN DRILL. EARLY ENGLISH
INVENTION.



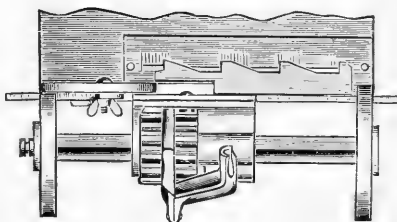
FOSTER, JESSUP & BROWN'S FORCE FEED,
NOV. 4, 1851.



C. P. BROWN'S PATENT, OCT. 9, 1868.
FORCE FEED.



PATRIC & BICKFORD, NOV. 26, 1867. FORCE FEED.



J. P. FULGHUM OCT. 30, 1877. FORCE FEED.

"It consisted of two seed-boxes with a coulter attached to each, and following each other; behind them followed a harrow to cover in the seed. His object in having two separate deposits of seed, and at different depths, was that they might not sprout at the same time, and so perhaps escape the ravages of the fly." Mr. Tull spent his lifetime and a fortune in developing this and other implements in the line of drills, horse-hoes, and cultivators, and died poor. His son died in prison for debt.

In Croker's "Dictionary of Arts and Sciences," published in London, in 1765, is the following description: "*Drill or Drill Box*," a name given to an instrument for sowing land in the new method of horse-hoeing husbandry (introduced by Tull). It plants the corn [grain] in rows, makes the channels, sows the seeds in them, and covers them with earth when sown; and all this at the same time, and with great expedition. The principal parts are the seed-box, the hopper, the plow and its harrow, of all which the seed-box is the chief. It measures, or rather numbers out the seed which it receives from the hopper, and is for this purpose an artificial hand; but it delivers out the seed much more equally than can be done by a natural hand."

Under the heading "*Sowing*" the author argues for the "drill way" in preference to the "common way" of spreading by hand, because of the regularity of distributing the seed and depth of planting, as well as the saving of seed by the use of the machine.

In Doddsley's Annual Register for 1764, a seed-plow is mentioned as having been made to go to York. It was mounted on two wheels, to be drawn by one or two horses. It made several furrows at once and would sow any kind of seed and cover at the same time, "all with great expedition and exactness." This was practically the crude predecessor of the modern grain drill. From this time on many inventions were patented, some of them simple and practical, others too complicated for successful use.

A clergyman named Cooke made many improvements in this line, some of which became a part of all British grain drills constructed since. His drill and horse-hoe described in Loudon's Encyclopedia in 1831, was a convertible machine, that is, the seed apparatus was made so it could be detached, thus making a cultivator of the implement. One of these seeders is described as follows: "The seed-box is of a peculiar shape, the hinder part extending lower than the fore part. It is divided by partitions and supported by adjustable bearings so as to preserve a regular delivery of the seed, while the machine is passing over uneven ground. The feeding cylinder is made to revolve by a toothed wheel which is fixed on each end of the main axle, and gears with other toothed wheels on each end of the cylinder. The surface of the cylinder is furnished with a series of cups which revolve with it and are of various sizes according to the different seeds intended to be sown. These deposit the seed regularly in funnels, the lower ends of which lead immediately behind the coulters, which are connected by a beam so as to be kept in an even line, and are capable of being held out of working, when desired, by a hook and line in the center. The seed, as it is deposited, is covered by a harrow fixed on behind. The carriage wheels are larger than usual, by which means the machine is more easily

drawn over uneven ground, and the labor of working is reduced. On this machine the grain spouts consisted of a number of tapering pipes or funnels fitted into one another so as to form flexible tubes."

From this it will be seen that early in the century the English had traveled far on the road towards the manufacture of grain drills, such as are now used. The Norfolk drill is favorably mentioned by Loudon. It sowed "a breadth of nine feet at once," and was quite generally used on light soils and on thin ground.

In the hand-drill barrow, described by Loudon, may be seen the predecessor of the one-horse drill, which is still used for covering beans and other seeds in the east and south and in other parts of the country, as well as for drilling corn. It is a suggestion also of the lister, a modern American implement. A wheelbarrow seeder, such as is used for sowing grass seed, was introduced in England about 1820, and it is stated that in certain parts of England and southern Scotland, a one-horse seeder on the same principle was in use for grain seeding, the seed-box being large and mounted above two low wheels.

The first patent on a seeding machine in America was granted in 1799, and up to 1836, when the Patent Office records were burned, patents had been granted to about thirty inventors in this line. It does not seem, however, that anything valuable had been contributed to the art beyond what we have noticed on behalf of the English inventors. The most important inventions that were left to be discovered were in the feed and in adjusting devices that to day distinguish American drills.

The manufacture of grain drills began in this country about 1840. A few drills had been brought over from England and introduced here, and efforts had been made to establish the manufacture of the machines, but nothing permanent resulted. The first important patent of which we have any record, was granted in 1835, and re-issued in 1838. It was on a machine designed to sow lime and plaster, and as re-issued showed that the invention was intended to sow grain, also. In 1837 another patent was granted, covering the application of centrifugal force, to sow lime, plaster and small grain. In 1838 a patent was issued for a grain drill in which a spring arm attached to a horizontal shaft revolved within the hopper and agitated the grain over the mouths of the tubes through which it was distributed. August 25, 1840, J. Gibbons, of Adrian, Mich., patented a grain drill with cavities to deliver seed, and a device for regulating its volume; and in 1841 he also patented a distributing cylinder, having several rows of cavities around its periphery, in combination with a hopper. These four patents were the only ones issued in six years, two of them, it will be noticed, being on broadcast seeding devices, and two on drills.

Among the early inventors who made substantial improvements in the invention of drills, were M. & S. Pennock, of East Marlboro, Pa., who made considerable progress in the development of "cylinder drills." Their first patent, dated March 12, 1841, and re-issued Oct. 30, 1849, covered the simultaneous throwing into and out of operation by a lever of each seeding cylinder, and its corresponding tube and drill, and made so as to use any number of hoes desired. It covered also an arrangement of spur wheels for

connecting the seed cylinders and hoppers to the shaft, so that they could be thrown into and out of gear when the drill was in motion. Many other patents were issued to this firm, most of them covering improvements in cylinder drills, in which a series of cylinders operated over a series of hoes or tubes. In the years following 1850, patents were issued on grain drills at frequent intervals, and it is unnecessary for us to follow them in detail.

By this time three different classes of drills were in the field, distinguished by their feeding devices. The first, of cylinder drills as built by the Pennocks and others; the second, as slide drills, in which the distribution was effected or governed by means of a slide; the third class, the force feed drills, which were then coming into use. Many of the slide drills used had a slide moved by a cam or crank motion to distribute the grain, and also a slide in the bottom of the grain-box to increase and decrease the quantity, by enlarging or decreasing the size of the opening for the passage of the grain. Others of this class used the slide in the bottom to govern the quantity fed and had a metal agitator or a rotary feed in the box to assist in the passage of the grain, and still others used two continuous flexible rollers to distribute the grain, which regulated the quantity by increasing or decreasing the distance between the rollers.

The first patent on a force feed for a grain drill was issued Nov. 4, 1851, to N. Foster, G. Jessup, H. L. and C. P. Brown, this invention introducing the name "force feed." The claim was as follows: "In combination with the seed-box *A'* and cap *n*, arranging the rotary disk *i*, vertically and providing it with the projections *j*, and the stationary vertical disk *b*, provided with an opening *h*, for receiving the grain, and the flanches *c e*, between which the said projections rotate, and by which the grain is carried from the seed-box to the cap, and thence to the seeding tube; the whole being arranged in the manner and for the purpose specially set forth and described." These parties had been associated in the manufacture of grain drills at Palmyra, N. Y., since 1849. In 1854 the Browns removed to Shortsville, and established a factory under the firm name of H. L. & C. P. Brown, the firm incorporating in later years as the Empire Drill Co. In 1866 C. P. Brown patented a modification of the original Foster, Jessup & Brown feed, which has since been used in the Empire drill, and is known technically as the "single distributor."

About this time C. E. Patric, who had been in the employ of the Browns, removed to Macedon, N. Y., and he and Lyman Bickford took out several patents in 1867, covering the "double distributor." The distinguishing feature of this invention was a seed-wheel or disk with carrying flanges on each side, one chamber feeding coarse, bulky seeds, like oats, and the other being smaller, to sow wheat, rye, etc. The invention was adopted by Bickford & Huffman, of Macedon, and in 1867 Mr. Patric went to Springfield, O., and licensed Ferrell, Ludlow & Rodgers, later Thomas, Ludlow & Rodgers, incorporated in 1883 as the Superior Drill Co.

October 6, 1868, C. O. Gardiner, of Springfield, O., assignor to Thomas & Mast, secured a patent on a force feed that, with later improvements from the same inventor, became known as the Buckeye. Oct. 30, 1877, J. P. Fulghum patented a force feed principle that has been adopted by a num-

ber of prominent western manufacturers. Many other feeding devices have since been invented and introduced, but those we have noticed laid the foundation.

Patents were granted at an early day on "adjustable rank" drills, or those having devices for shifting the hoes from a straight rank to a staggered position. One of the most important was that of Charles F. Davis, Feb. 18, 1868.

About twenty-five years ago inventors turned their attention to shoe drills, a class that has become popular in the western trade. Cooke's early English drill shows a hoe that is in some measure suggestive of the shoe, but it is not likely that inventors had their inspiration from this source. Brown, of corn planter fame, had introduced the principle of a shoe so shaped as to cut through or rise over obstructions; and it was but a step to adapt this invention to the grain drill. Springs for holding the shoes into the ground were attached, as well as chains or wheels for covering the seed, and other devices, but it is not necessary to trace their development in detail.

The broadcast seeder, with a slide distributor, and later a force feed, preceded the drill in general use in the west and is still extensively manufactured, several makers exhibiting samples at the Columbian Exposition. In recent years they have been largely replaced in popular favor by disk seeders convertible into disk harrows.

Fertilizer distributors are quite generally used on drills in the east, but the western farmers have only in a few localities begun the use of commercial fertilizers. Grass seeding attachments are in general use.

CHAPTER IV.

Corn-Planters and Check-Rowers.

THE practical development of the two-horse corn-planters now in general use throughout the west and southwest dates from 1853. Although there was a patent granted in 1799 to Eliakim Spooner for a seeding machine, followed by about thirty other patents in the class of "seeders and planters," issued prior to 1836 (the year in which the patent records were destroyed), and the man who conceived the idea of the corn-planter was probably among this number, a review of the art will show that nothing available for introduction into general use had been invented prior to the year mentioned.

D. S. Rockwell's patent, March 12, 1839, shows a planter with four wheels of equal size and two seed-boxes and was intended to plant two rows. Furrows were opened for each row by a peculiarly shaped shovel, behind which the seed was dropped between two diagonally set blades, the combination of shovel and blades being faintly suggestive of the modern shoe. The rear wheel, set behind the blades, covered the corn and packed the earth as in the modern planter. The seed was dropped from the hopper by a device "consisting of the slides placed above and below the partition, and operated upon by means of a toothed segment and pinion, arranged substantially as set forth, and set in motion by one of the bearing wheels."

The next patent, to G. Mottmiller, of Columbus, O., Sept. 1, 1843, covered a frame jointed to the axle, but had other features not consistent with a practical planter. E. Wood's invention, patented Jan. 10, 1845, was intended for drilling two rows of potatoes, but had many features of a successful corn-planter. Edward Wicks, of Bart Township, Pa., patented March 26, 1850, a planting cylinder containing cells or cavities that could be enlarged or diminished as might be required. D. B. Rhodes, of Concord, N. Y., patented in December, 1850, a double-row planter in which the hopper had two sliding bottoms arranged to measure and drop the seed. In C. Van Every's planter, one wheel, about four feet in height, had an intermittent gear with cogs at three points on its periphery to operate the dropping device, so as to plant three hills with each revolution of the wheel, which was about four feet high. It will be observed that all the inventions mentioned thus far had automatic dropping devices, but in the next patent, to M. Corey, of Jerseyville, Ill., Oct. 28, 1851, there was a claim covering an indicator to point out "the place where corn has been planted," suggestive of operating the dropper by hand. The next and last patent previous to the appearance of a generally successful planter, was granted to H. Vermillion, of Rising Sun, Ind., Nov. 2, 1852, and covered a peculiar distributing device.

The aim of these early inventors was evidently to produce an automatic planter, and nothing practical came of their efforts because the real need of the western farmer was a planter that would place the hills *in check*, so the corn could be plowed both ways. A device for dropping the corn by hand or in some way under the direct control of the operator must be combined with means for opening the furrow and covering the corn. This was done by Geo. W. Brown, of Tylersville (later of Galesburg), Ill., whose first patent was issued Aug. 2, 1853, but afterward re-issued Feb. 16, 1858, and again re-issued Sept. 11, 1860. It is said that Mr. Brown used his planter successfully as early as May, 1851. In his first patent in 1853 he claimed: "The oscillating horizontal wheels or distributors, in the bottom of the hopper, having slots and holes of various sizes, in combination with stationary caps and pins, for the discharge of different kinds and quantities of seeds. Also, the arrangement of covering rollers, mounted as described, and performing the purposes of covering the seed, elevating the cutters in turning around, and in adjusting them to different depths." As re-issued in 1858 the patent had only one claim: "A shoe for opening a furrow, which has a convex edge in front and a seed-tube in its rear end, so that it may cut through any grass, open out a furrow and hold it open until the seeds are deposited in it, substantially as herein set forth."

In the re-issue of Sept. 11, 1860, all the new features in Mr. Brown's planter were covered in five divisions or claims. Briefly stated, the first division covered the frame, supported in front on not less than two runners or shoes with upward inclining edges, and the rear part supported on not less than two wheels, the latter being arranged to follow the former. The second division covered the shoe or runner, edged and curved upward in front so as to climb, cut or break through obstacles, and widening toward its rear end so as to open a furrow for the seed; and also made long enough to furnish support to the framework. The third division covered the hinged joint between tongue and rear of the machine, so that one part of the frame might be raised, lowered, adjusted or supported on the other part. The fourth division claimed the operation by hand of the dropping mechanism, by an attendant riding on the machine, in position to see the marks for the corn and to operate in conformity therewith; also the lever and its arrangement by which the driver could raise the framework and seeding devices carried thereon, to aid the machine in passing over obstacles and in turning around. The fifth division claimed in combination with runners and covering wheels, a pair of auxiliary wheels and an axle for the double purpose of taking the weight off the runners and covering wheels, and for affording means for converting the machine from a planter operated by hand to an automatic seed-sower; and also hanging the axle of auxiliary wheels in adjustable arms or levers so that more or less of the weight of the machine might be placed upon said auxiliary wheels.

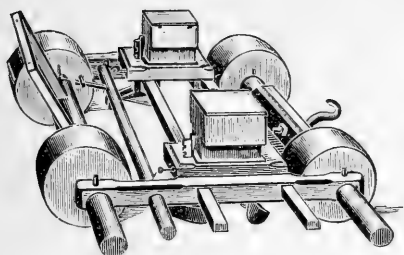
Other patents were granted about this time. One to L. Caswell, of Harrison, Me., Aug. 1, 1853, covered an adjustable axle; another to E. Marshall, of Clinton, N. J., April 11, 1854, was on automatic dropping devices; and still another to M. Ward, of Owego, N. Y., March 27, 1855, covered a slotted adjustable share and short compressing blocks on the periphery

of the wheel, to press the earth over the seed and at the same time mark the hill. Geo. W. Brown's second patent was issued May 8, 1855, and claimed: "In combination with the hoppers and their semi-rotating plates, the runners *P*, with their valves *e*, and their adjustment by means of levers and cams, and the driver's weight, for the purpose of carrying and dropping seeds by each vibration of the lever *D*, and to regulate the depth of planting as described."

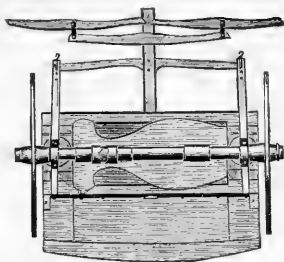
This second patent of Mr. Brown's was re-issued Nov. 10, 1857, and again Dec. 11, 1860. As re-issued it covered: Placing seats of driver and dropper so that one balanced the other; making driver's seat adjustable so he could put more or less of his weight on the seeding apparatus and thus regulate the depth; hanging the seeding apparatus on hinged joints so it could be raised out of the ground and carried on the wheels and tongue; a stop for preventing rear part of frame from descending too low when the forward part was raised and carried; and finally, an improvement in dropping device, by which, with one lever, the seed passages could be opened and closed at regular intervals to pass measured quantities.

The first patent on a marker was granted to E. McCormick, Oct. 16, 1855, for a device projecting from the end of the axle. F. Goodwin, of Astoria, N. Y., March 3, 1857, showed in his patent the first marker that could be changed from one side to the other, but did not make any claim on it, and Kuschke and Merkel, of St. Louis, in their patent of May 26, 1857, made no claim for their markers, one on each side of the planter, arranged so as to be folded over the planter when not in use. The marker as used to-day was shown in the invention of Jarvis Case, of La Fayette, Ind., whose patent, under date of Dec. 1, 1857, showed a marker having a double-edged shoe, and hinged so that it could be turned over to mark on either side, or be raised clear of the ground in turning.

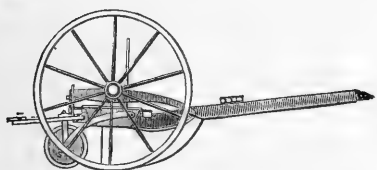
Many other inventors contributed their ideas and work to the evolution of the modern planter, which represents the simplest and best devices of all combined into one, though of course there are points of difference in nearly all the planters of standard makers. J. W. Vandiver in 1863 patented adjustable covering shares, a feature of the old Vandiver planter made at Quincy, since improved by J. C. Barlow, his associate and the head of the Barlow Corn Planter Co. Galt & Tracy, of Sterling, Ill., were large manufacturers of planters of the "open heel" drop pattern in the early days, beginning in 1867, and they contributed many improvements. An early patent of Geo. W. Brown shows the principle of the rotary drop, in which the dropping plate is rotated by intermittent steps, moving forward with either a right or left motion of the dropping lever. The Deere & Mansur Co., of Moline, Ill., are accredited with pioneer work in adapting this rotary drop to a check-rower. The Moline Plow Co. introduced a few years ago the principle of gearing the dropping mechanism to the wheel of the planter so as to drop one kernel at a time into the valve. The advantage of this device, which has been generally adopted by manufacturers, is that the corn can, if desired, be planted in hills with a check-row attachment, or the check-rower can be taken off and the corn drilled in. The Fuller & Johnson Mfg. Co. of Madison, Wis., have introduced what they term a "force



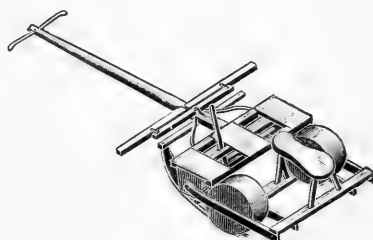
D. S. ROCKWELL'S PATENT, 1839.



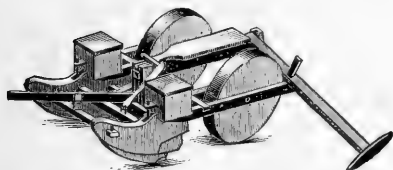
GEO. W. BROWN'S FIRST PLANTER, 1853.



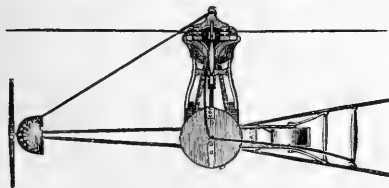
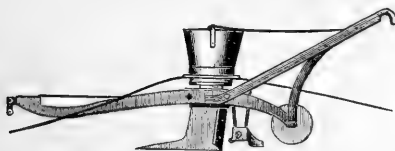
SIDE VIEW, BROWN'S PLANTER, 1853.



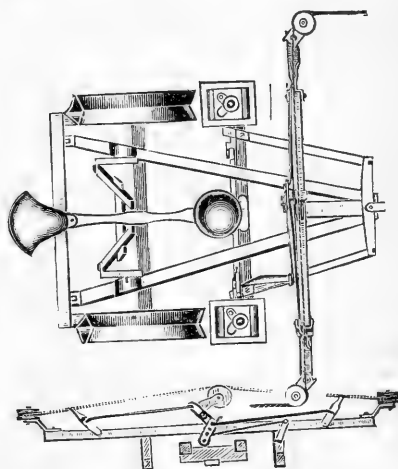
GEO. W. BROWN'S PATENT, 1855.



JARVIS CASE PATENT, 1857.



M. ROBBINS, PATENT, 1857.



G. D. HAWORTH'S PATENT, 1870.

feed," a peculiar form of secondary drop, operating in the valve of the planter. The H. P. Deuscher Co., of Hamilton, O., have as a feature of their planter a telescoping axle, by which the wheels can be moved away from the rows when it is not best to pack the soil on the corn.

Within the last year or two steel has been generally adopted in the construction of planters, the Farmers Friend Mfg. Co., of Dayton, O., leading in the change. Many other improvements and adaptations might be noticed, but enough has been said to point out the landmark patents and improvements.

The lister is a modified form of corn-planter that is used extensively in the southwest where the soil is dry and other conditions are favorable to this method of planting. The distinguishing feature of a lister is a small double mouldboard plow adapted to opening a furrow (generally with a subsoiler running behind to make a seed-bed), in combination with a covering wheel, a seed-box and mechanism actuated by the covering wheel for dropping the corn. Sometimes a lister is mounted on two wheels like an old-fashioned sulky plow, and still other forms and adaptations have been used.

The advantage of planting in this manner is that the seed is covered in the bottom of a furrow, and is better prepared to withstand the dry weather common in the southwest, and besides, planting can be done without first plowing and harrowing the land. In dry seasons a lister could be used to advantage in Illinois and other central states, but generally there is too much moisture in the ground.

The introduction of the lister dates back about fifteen years. Several patents were granted to Missouri and Kansas farmers, and the implements were at first made in small numbers by local blacksmiths. The Parlin & Orendorff Company of Canton, Ill., were the first of the old line plow manufacturers to make the new implement in quantities for the trade, the late Wm. Parlin having given considerable attention to its development.

THE CHECK-ROWER.

The first invention of a planter to drop in check automatically, is accredited to M. Robbins, of Cincinnati, Ohio, whose patent of Feb. 10, 1857, covered a reversible hopper, an arm with vibrating claw or tappet connected with the seeding mechanism, in combination with a jointed rod or chain provided with buttons. This patent was re-issued Feb. 9, 1858, with three claims, the first covering the dropping of seed from a plow or drill by means of an anchored chain or its equivalent, the second claim covering the chain or cord, and the third claiming an arm with a vibrating claw or tappet, or equivalent devices, operating the seed discharging mechanism. Mr. Robbins' invention was practically a one horse drill, with the chain or rod attached as patented, and it did not become known as a "check-rower." This name was given to later inventions of the Haworths and others, who had in view a separate attachment to be put on any planter. A few planters Robbins made worked well, but they were not practical and he died poor.

The next patent following that of Robbins was issued to John Thompson and John Ramsay, of Aledo, Ill., Sept. 29, 1864, and covered "the employment or use of a wire or cord, provided with knots at a suitable distance

apart, and applied to the machine substantially as shown in connection with anchors." This was re-issued as assigned to G. D., J. W., L. L. and M. Haworth, Dec. 21, 1875, and again Oct. 31, 1876. The last re-issue covered the knotted cord for actuating seeding devices; guides or pulleys arranged to transfer said cord from one side of the machine to the other in its passage over the same; the combination with the rock shaft operated upon the cord, of forked arms or levers placed one at each end of said rock shaft and adapted to be operated upon alternately by the cord; and finally, the arrangement of seeding devices in connection with the cord, whereby the latter could impart positive movement in one direction to seeding devices. April 24, 1866, W. W. Hubbard, of Edinburg, Ind., obtained a patent for various improvements, which also was re-issued to the Haworths, March 27, 1877. This covered horizontal traversing bars for automatically moving check-row cords at the end of the field, and a movable arm for supporting on machine when turning. G. D. Haworth took out a patent on check-rower devices Feb. 22, 1870, and several others were issued later to the Haworths in the same line.

A patent was issued to Alden Barnes, of Bloomington, Ill., Nov. 5, 1872, and was re-issued in two divisions Feb. 20, 1877, covering several devices, the most important being a check-row chain made with knots formed by coiling a piece of wire around the main wire. It was assigned to the Chambers, Bering, Quinlan Company, of Decatur.

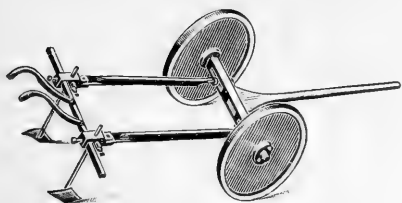
Improvements now became necessary in the dropping mechanism. The slide drop had become too slow for use on the check-rower, and a rotary drop was therefore devised and adopted. With this invention the development of the more important features of the check-rower was completed, although many changes and improvements have been made from time to time by leading manufacturers in the details of its construction.

CHAPTER V.

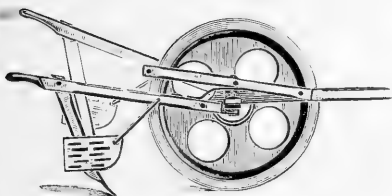
Corn Cultivators.

AS in the case of the two-row corn-planter, the development of the "straddle-row" sulky cultivator has been since 1850. In fact, it would seem that the development of these two implements has been on parallel lines, so inseparably connected have they been with the history of modern corn-growing methods in the Mississippi valley and elsewhere. The corn-planter came first in the conception of inventors, and its use by the farmers no doubt created the demand for a cultivator that would be more efficient and rapid in its operation than the old type of horse hoes that had come down, with little improvement, from the hands of Jethro Tull. Altogether, the two implements have made it possible for one man to grow forty acres of corn in connection with other farm work on a like scale, a result that no doubt seems impossible to the farmers of the eastern part of our own country; but that is almost the average of those making a specialty of corn-growing in the west. It is not the author's intention to treat in this chapter of horse hoes, called cultivators in the east. It is true they were the predecessors of the modern sulky cultivators, but there seems to have been an intermediate stage in the development of the corn cultivator. For many years prior to the invention of Esterly, to be noticed further along, wheel cultivators had been used to prepare fallow ground for seeding without the use of the plow. These old implements had two wheels carrying a frame with a vertical adjustment, to which the shovels were hung, as well as a seat for the driver and numerous other devices for convenience in operating them or for making their work more effective.

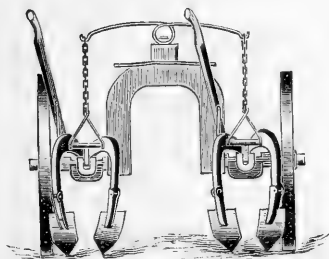
It would be a natural evolution for inventors to next think of dispensing with the shovels in the middle and hanging the others on two separate gangs, which could be attached to the axle or frame and drawn by hinged or swivel couplings. This, in fact, was the next step that was taken. The first patent on a sulky cultivator having a combination of these principles was granted to George Esterly, of Wisconsin, the famous inventor and manufacturer of grain headers. It was dated April 22, 1856. Aug. 26 of the same year, H. D. Ganse, of New Jersey, patented a cultivator having means for controlling the gangs by the feet. Jan. 13, 1857, J. Shaw, of Georgia, patented a cultivator in which the hoes or shovels had a swivel adjustment to throw the dirt to and from the plants. N. Whitehall, of Indiana, patented April 27, 1857, a cultivator in which the axle was arched over the row (Esterly's patent and others showing only a straight axle), and which also had an evener suspended upon three points. A drag fender or shield, attached to the gangs on each side, was covered in the patent of N. Fraser and A. J. McClellan, Aug. 10, 1858.



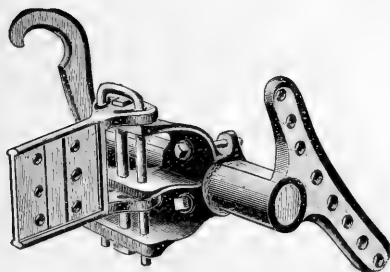
GEO. ESTERLY'S PATENT, 1856.



B. TINKHAM'S PATENT, 1860.



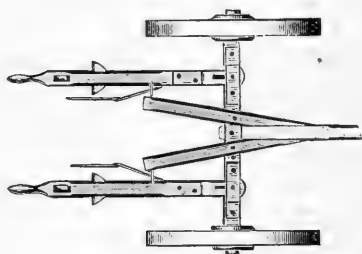
W. P. BROWN'S PATENT, 1872.



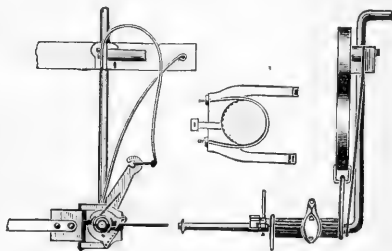
W. P. BROWN'S COUPLING, 1879.



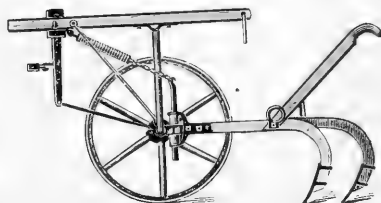
P. COONROD'S PATENT, 1867.



PLAN OF TINKHAM'S CULTIVATOR, 1860.



BROWN'S PATENT, 1877.



GILPIN MOORE'S SPRING AND COUPLING, 1879.

James Dundas, of Illinois, later of Nebraska, secured Feb. 8, 1859, a patent, re-issued Oct. 16, 1866, in which there were six combination claims on the use of two wheels on a cultivator arranged with two gangs with a space between them, a seat for the driver, and means for moving the gangs laterally and raising the plows relatively to the treads of the wheels.

B. Tinkham, assignor to Hapgood & Co., an old Chicago firm of plow makers, obtained a patent Dec. 11, 1860, that was re-issued Jan. 10, 1871. It claimed a beam hinged or pivoted to an axle by a joint, whereby the beams with their shovels had both a vertical and lateral swing in an upright position. It also claimed a rearward extension of the arched axle of the plow, with supports on it for holding up the gangs when not in operation. The name of L. B. Waterman, of Chicago, first appears in a patent issued to him May 13, 1862, covering an adjustable seat, a feature of the Waterman cultivator, built for many years by Furst & Bradley.

J. A. Thorp and John Cox, of Michigan, patented Jan. 27, 1863, the use of a yielding connection or wooden peg in the shank of the gang, so that the shovel might yield when it came against an obstruction that would otherwise break it.

The patent issued to P. Coonrod, of Illinois, Dec. 24, 1867, shows a coupling with a sleeve fitted on the axle, as illustrated, this laying the foundation for the Brown and later patents using a sleeve or box. July 9, 1872, a patent was issued to W. P. Brown, of Zanesville, Ohio, on a spring, the claim being worded as follows: "Spring arms and chains for suspending the weight of the shovel beams, substantially as and for the purpose described." May 15, 1877, an important patent was issued to the same inventor on a coupling and spring, and Jan. 3, 1879, still another patent covering details of what is known as the Brown coupling, more generally used by manufacturers than any other.

July 22, 1879, a patent was issued to G. Moore, of Moline, Ill., covering the use of a spring and coupling, as shown in illustration. Dec. 16, 1879, E. A. Wright, of Iowa, patented a peculiar spring, the principle of it being to exert a lifting strain on the gang after it has been raised above its operating position, and to bear down on it, rather than lift it, while it is in the ground. Byron C. Bradley, of Chicago, April 27, 1880, shows the use of a "C" spring and chain, the spring being mounted directly on the coupling, and, therefore, independent of the upper part of the frame. This patent also shows a draft spring. E. A. Wright, of Iowa, was granted a second patent June 7, 1881, covering more fully the principle of his double-acting spring. Since that time many other patents have been issued on changes of form, and on the adaptation of springs and couplings.

For many years following the introduction of cultivators, the popular style was the "long swing," in which the coupling was located forward of the axle, and thus permitted the use of longer beams, and gave the gangs a long, easy swing. Cultivators with the coupling at the axle, however, were in the field early, and soon grew in favor on account of their convenience and compactness.

Many adaptations of the standard type of cultivator have been made by inventors, for corn cultivation and other uses. Disks in place of shovels

have been introduced by a number of manufacturers, and meet with favor. Spring teeth, an adaptation of the old Garver harrow tooth, have also come into favor, the late Horatio Gale, of Albion, Mich. (founder of the Gale Manufacturing Company) having given considerable attention to their development. D. S. Morgan & Co., of Brockport, N. Y., make a "spading" cultivator, and the Cutaway Harrow Co., of Higganum, Conn., have introduced their "cutaway" disks in this field.

Within the past few years many styles of "tongueless" walking cultivators have been put on the market by manufacturers, and have met with a favorable reception. They have the advantages of general convenience, light draft, flexibility in the frame so that the gangs can be held more steadily and nearer to the corn when it is small, and less room is required for turning at the side of the field. For these and other reasons, they are preferred by farmers who are not averse to walking.

Manufacturing in this line is now largely in the hands of the steel plow manufacturers, each of whom has patents covering distinctive devices in couplings, springs and other parts.

[Chapters VI, VII, VIII, and IX on Reapers, Harvesters, Automatic Binders and Mowers, are substantially the historical articles compiled by C. W. Marsh and published in the *Farm Implement News*, beginning in January, 1886. Nearly all the chapters of this book are written from data compiled by Mr. Marsh, but those specially referred to are practically his writing.]

CHAPTER VI.

The Reaper.

THE harvesting of grain when ripe and ready to gather has been, until within a few years, the most burdensome and exacting operation on the farm. It may not be delayed like other work, for if not promptly done the farmer might lose all the fruits of his previous labors, and unless properly and carefully performed his losses may still be severe.

Harvest was a season of toil and anxiety, and its close among most nations was celebrated by general rejoicings. Games and rustic fêtes marked the final ingathering of the sheaves. The husbandmen ceased their labors and threw off their cares in rounds of uproarious jollification. In the old simple days of England the "Harvest Home," or close of the season, was such a scene as Horace's friends might have expected to see at his Sabine farm, or Theocritus might have described in his Idyls; and possibly such scenes were presented in those ancient times. The last sheaves were brought home in what was called the hock-cart, surmounted by a sheaf formed and dressed to represent a female figure—presumably the goddess Ceres—or by pretty girls of the reaping band fantastically attired and crowned with flowers. A pipe and tabor led the procession, while the reapers danced around shouting:

"Harvest-home, harvest-home,
We have plowed, we have sowed,
We have reaped, we have mowed,
We have brought home every load,
Hip, hip, hip, harvest home," etc.

Those merry days have long since passed. Our age is hard and practical. Everything now is done for gain, and this disposition has chilled the simple, joyous customs of our fathers; besides, modern invention has rendered harvesting as ordinary a process as any other on the farm, and has deprived it of many of the features which in old times made it important and interesting.

The farmer, who, driving from a comfortable seat, rolls off ten or fifteen acres of well-bound sheaves per day from his machine, has but little conception of the amount of painful study and expensive experiments, of the many inventions it has required to bring from the ancient sickle to the machine with which he so easily gathers his grain, such perfection as it has attained.

For such development the world is indebted, first, to inventors purely; second, to men who arranged and combined crude inventions or devices into practical machines; and, third, to foresighted business men, who, recognizing the value of improved machines, put them upon the market as trade ventures. Some who have been prominent in this line have com-

bined these attributes in a greater or less degree, but this general classification can be maintained. Either class, and especially the third, has been inclined to assume more than its share of credit, and profit also, but history should, though it seldom does, right such matters so far as it can, and give credit only where it properly belongs.

There is no record of any machine constructed to reap grain otherwise than by hand until about the close of the last century. There was unquestionably a stripping harvester used by the Gauls early in the Christian era, but as it was not properly a reaper, it will be noticed further along under harvesters.

"In the summer of 1870," says Mr. Marsh, "I spent several pleasant days at an agricultural college in Ungarisch Altenburg, a little town situated upon an arm of the Danube, which puts out from the main river not far below Vienna, and returns to it at Raab. While there I was shown a model of a primitive reaper in the college museum, built somewhat after the style of the Kerr machine made in 1811. It had a revolving perpendicular drum, carrying a projecting circular knife at its base, and a rim at the top notched so as to catch and carry the heads of the cut grain, and, in connection with the knife, operating on the butts as the drum revolved, to deliver in a swath outside of the line of the cut. This drum with its knife and notched rim was revolved, as I remember, by a crossed belt on a system of pulleys from the axle, between the two wheels, which supported the drum, suspended before them to a pulley on an upright spindle through the center of the drum. It had shafts reaching back for the animal which pushed it forward, and it was altogether a simple contrivance which might work fairly well. The professors told me that this model was a reconstruction from an engraving on a stone found in this vicinity (the country here is level, exceedingly fertile, and was colonized by fugitive Cathagenians during the third Punic war, about 150 B. C.), and that this stone had been verified by similar lines of figures found engraved among the ruins of Carthage. It may be further said that the Cathagenians were an exceedingly enterprising, ingenious and practical people, noted for trade and manufactures. It was of them the old Romans said that their only aim in life was 'to buy cheap and sell dear.' They were infinitely more advanced than the Gauls, who used the stripping harvester or header not so very long after, and they might have produced either."

The publication just one hundred years ago by the Society of Arts, Manufactures and Commerce, in Great Britain, of Pliny's description of the stripping harvester used in Gaul, brought out two years after an answering machine from Mr. Pitt and one or two others of the same class. The first patent granted for a reaping machine was obtained in England by Joseph Boyce, July 4, 1799, which is only remarkable because of being the first. In the following years several patents were granted, but it is impossible to notice within the scope of this book any other than those which first show some feature that has remained as a necessary part of a practical reaping machine to this day; and as this movement began in England, we will continue with British inventors for a time. Gladstone, in 1806, produced a reaper mounted on two wheels, which was drawn from the front, with side

cutting apparatus, and a segmental bar having fixed guard teeth therein for gathering and holding the grain while being cut. In 1807 Mr. Plucknett had a machine, which, as described, was drawn from the front and side, and a driver's seat is shown thereon. The machine, which he patented in 1805, a crude thing, had gatherers, or outside and inside dividers. Both Gladstone and Plucknett used revolving cutters. Salmon's reaper in 1807 had a divider or "projecting bar which separates the standing corn [grain] from that to be cut," supported by a grain wheel, the latter arranged to raise and lower the cut of the machine. It had vibrating knives cutting over stationary edged guards, like shears, and it had also an upright, pendulous, vibrating self-rake, worked by a crank, which swept across the cutting apparatus at regular intervals, depositing the grain in gavels or bunches at the side.

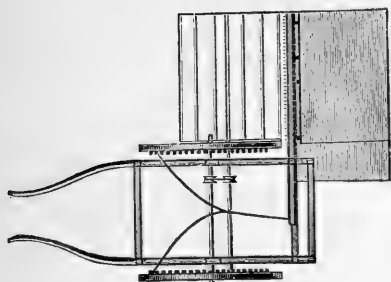
In 1811 two reapers upon like novel principles were invented, one by Smith and the other by Kerr, the cutting being accomplished by a circular knife projecting from the base of a drum and revolving therewith. An illustration of the Kerr machine is shown.

In 1814 a theatrical genius by the name of Dobbs invented a reaper, which he advertised by introducing it upon the stage, the latter being planted with wheat and cut by the machine during the course of a play adapted to it.

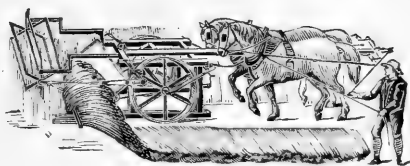
Mr. Scott, in 1815, produced a peculiar reaper with a circular cutting movement, the cutters having serrated edges, the only lasting feature being his grain divider and inside gatherer, which he described as follows: "There was fixed on the long right hand prong *P*, Fig. 3, a sheet of thin plate iron kneed to the same acute angle with the prong, and of the same height with the drum, for the purpose of dividing the standing corn from that to be cut, and there was also an inclined piece of sheet iron, etc., so placed on the left hand side."

Mann's machine, in 1820, carried the cut grain off into a swath with revolving rakes. It had a regular tilting lever by which "the director of the machine has it in his power to raise or depress the forepart and cutter at pleasure." It was raised and lowered on the carrying wheels, and "for this purpose the axles of both wheels of the carriage are supported in sliding bars with guide rods, *N*, *N*."

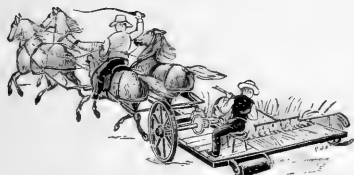
[And now we come to the most original, the cleanest, simplest and greatest single invention ever made in harvesting machinery, that of Henry Ogle, a schoolmaster of Rennington, assisted by Thomas and Joseph Brown, founders, at Alnwick, England, in 1822. This schoolmaster possessed inventive genius of a high order, and a modesty equal to his ability. He says, in a description of his invention and their efforts: "I made a small model, but not being a workman myself, and being on very friendly terms with one Thomas Brown, a founder, and his son, Joseph Brown, I presented it to them." After describing their first efforts, he says: "They then made the teeth [guards] shorter and tried it again, in a field of wheat. It then cut to great perfection, but still not laying the corn [grain] into sheaves, the farmer did not think that it lessened the expense much." Mr. Brown took it home again, and added the part for collecting the corn into a sheaf,



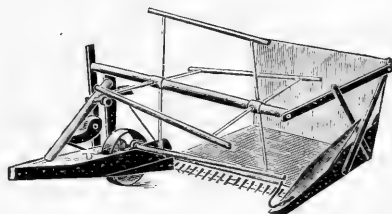
THE OGLE REAPER, 1822.



BELL'S REAPER, 1826.



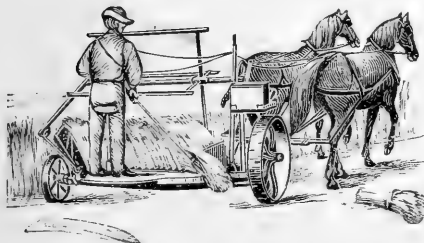
HUSSEY'S REAPER, 1833.



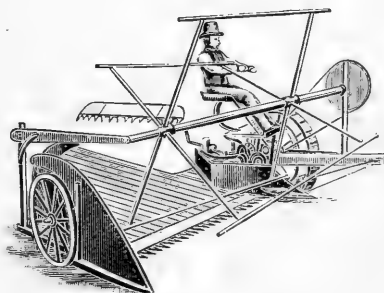
MCCORMICK'S REAPER, AS BUILT AT BROCK-
PORT, N. Y., 1846



AMBLER'S SICKLE BAR, 1834.



THE JOHN P. MANNY REAPER.



THE NEW YORKER SELF RAKE.

G, G (the platform), when he tried it again at Alnwick in a field of barley, which it cut and laid out into sheaves remarkably well. Messrs. Brown then advertised at the beginning of 1823 that they would furnish machines of this sort complete for sheaving corn, "but farmers hesitated at the expense, and some working people at last threatened to kill Mr. Brown if he persevered any further, and it has never been tried more." It was estimated from the cutting it did to have an average capacity of fourteen acres per day. By reference to the illustration of this machine it will be seen that it had all the elements of the modern hand-raking reaper and dropper. It was drawn from the front and side. It was supported on two driving wheels. It had the ordinary reel. It had the projecting bar with the guard-teeth, a reciprocating knife or sickle, cutting over said guard teeth, and a grain platform attached to and behind the bar. Hinged, it was used as a dropper; rigid, the grain was put off in gavels to the side. In the words of Mr. Ogle, this frame or platform, *G, G*, when hinged, "is lifted till as much corn is collected as will be a sheaf, and let fall by a lever, *H, H*, over a fulcrum upon the frame *B, B*, etc., when the corn slides off, when it is a little raised again. It was found, however, to answer better when it was put off by a man and a fork toward the horse, as it is easier bound and leaves the stubble clear for the horse to go upon."

From the position of the lever it is certain that a seat was provided for its operator. As the grain "was put off by a man and a fork towards the horse"—not raked—the forker probably stood on the machine; and, unquestionably, as the machine was made for use in the field, it had a grain wheel or shoe, divider and inside gatherer, as these had been previously invented, described and publicly used; and also other necessary parts to make it fully operative. For Mr. Ogle says, in closing his description: "I have only given a part of the framing [construction], as most mechanics take their own way of fixing the main principle."

The next and last British reaper which we need notice was invented by Rev. Patrick Bell, of Carmyllie, Scotland, in 1826. The illustration shows its construction so clearly that a general description is unnecessary. It had a shear-cutting apparatus, the lower cutters being fixed, the upper shearing across them, with an advancing movement also. The grain was delivered against the cutters by an adjustable reel, and was carried to the side by a revolving canvas or endless apron, as shown.

This machine worked well, and quite a number of them were built for the market. One at least was shipped to America in 1834 to John B. Yates, of Chittenango, Madison county, N. Y., who used it successfully.

Here we may leave British inventors, conceding to them that the hand-rake reaper, self-raker and dropper were invented by them. But they were inventors simply, while progress and practical development were due to American invention and enterprise—to the men who arranged and combined old devices into practical machines, inventing improvements and perfecting details, and also to men of business foresight, who put such improved machines upon the market. Unquestionably some devices were doubly invented, i.e., on both sides of the water, as there was so little communication between the two countries in the early part of the century.

American invention in this line, so far as there is any record, began with the patent issued to Richard French and T. J. Hawkins, of New Jersey, May 17, 1803. No reliable description of this machine seems to be extant. Five patents of no general importance were issued between that time and Feb. 13, 1822, when Jeremiah Bailey, of Pennsylvania, took out one for cutting grass or grain. This machine was supported on two wheels, one only being the driver; the horse walked to the side and front and the circular scythe frame projected into the grain. It was the first to indicate the principle contained in a flexible bar, as "with the inequalities of the ground the scythe frame, shaft and trundlehead rise and fall." E. Cope and J. Hooper, Jr., of Pennsylvania, obtained a patent May 18, 1825, for a machine which was considered simply as an improvement on the Bailey, having the same general principles but being less complicated in construction. It is claimed that this machine worked well.

The next invention showing marked progress was that of Wm. Manning, of New Jersey, patented May 3, 1831. His reaper had two ground wheels fixed to the same axle, from which a frame extended having a bar attachment provided with guard-teeth, over which a sickle with spear-shaped sections reciprocated. This was substantially the scalloped sickle. Three inventions, of no importance, except Schnebly's, 1833, which had an intermittent endless apron gaveler, are mentioned between the date of Manning's patent and that of Obed Hussey, Dec. 31, 1833.

Hussey's machine was principally remarkable for its compact form, its hinged frame, and for the novel construction of its guard-teeth, which were made double or slotted, so that the scalloped or zigzag knife might vibrate through the openings, the space between each guard, from center to center, being as wide as the distance between each point on the knife or sickle. This was a marked improvement, and the machine was really the first one made sufficiently practical to find a regular market and to come into general use. Its manufacture began in 1834; it was introduced into different states immediately following; it was built in substantially the same form (though guards were improved in 1847) continuously up to about the time of Hussey's death, and its chief feature has been incorporated in all harvesting machines made since.

To Bernard Jackson, of Ohio, was granted a patent, June 14, 1834, for a four-wheeled reaper having "discharging arms, which are to deposit the grain as it is cut behind the left side of the machine."

The next patent was granted to Cyrus H. McCormick, of Virginia, June 21, 1834. After describing his machine, he says: "And I particularly claim the cutting by the means of a vibrating blade, operated by a crank, having the edge either smooth or with teeth, either with stationary wires or pieces above and below, and projecting before it, for the purpose of staying or supporting the grain whilst cutting; or the using a double crank, and another blade or vibrating bar, as before described, having projections before the blade or cutter on the upper side, both working in contrary directions, thereby lessening the friction and liability to wear by dividing the motion necessary to one between the two."

McCormick built only a few experimental reapers such as he described

in this patent. They were not sufficiently practical for the market. But in 1845 he went to Brockport, N. Y., and arranged with Seymour & Morgan to make his machine as improved. One hundred were built for the harvest of 1846, which were fairly successful. Not long after he went to Chicago and began his eminently successful career as the manufacturer of his reaper, which soon became well known throughout the west.

December 23, 1834, Enoch Ambler, of New York, obtained a patent about which but little can be learned. It is understood, however, that he used the first wrought-iron finger-bar with steel guards and steel shoes. The illustration shows what is said to be his old bar. Abraham Rundell, of New York, April 22, 1835, patented a machine with double-acting scissors cutters, and also with a raking and discharging device. A number of patents containing nothing particularly new were granted during the balance of this year, and until June 28, 1836, when H. Moore and J. Hascall, of Michigan, obtained one on some valuable features; but as this machine was a harvester it will be described farther along. Again we pass over several patents obtained for various devices until we come to that of Jonathan Reed, of New York, March 12, 1842. He claimed vibrating knives with serrated edges in combination with serrated guards; also a peculiar self-rake, the teeth of which projected through slots in the platform. Passing along again over useless inventions, or those relating to harvesters, we stop at the name of Wm. F. Ketchum, of New York, but his patent of Nov. 18, 1844, was of little consequence.

January 31, 1845, C. H. McCormick obtained a patent covering "the curved (or angled downward for the purpose described) bearer for supporting the blade," the reversed angle of the teeth of the blade, the construction of the guards so as to form angular spaces in front of the blade, the combination of bow and dividing iron for supporting the grain, and the position of the reel-post on his machine.

Wm. F. Ketchum, March 7, 1846, obtained a patent on a machine having the driving wheels under the grain platform; and Clinton Foster patented, April 18, a self-rake which swept across the platform as controlled by the operator. This was quite an advance in the direction of a practical self-raking reaper. Alexander Wilson, of New York, Sept. 3, got a patent on several devices, the one noticeable being upon the construction by which cutters may follow the undulations of the ground independent of and not affected by the up and down movement of the horse." Nov. 20, Andrew J. Cook, of Indiana, obtained a patent on a revolving reel rake, the first of its class.

Wm. F. Ketchum came to the front again July 10, 1847, with an ingenious and simple machine, which made quite a sensation at the time. There was an endless chain of cutters on a bar projecting from the center of the drive-wheel which did not prove practical, but his bar was made to sweep the ground only the length of the cutting part, then angled up to the drive-wheel frame. As this is the common way of making and attaching finger-bars, the invention was valuable.

Obed Hussey, Aug. 7, 1847, obtained his important patent for fastening the upper piece of the guard to the lower piece at the point, leaving the

back end unconnected, so as to prevent choking, as all guards are now made.]

C. H. McCormick, Oct. 23, obtained another patent on his machine for "placing the gearing and crank forward of the drive-wheel for protection from the dirt, etc., and thus carrying the driving-wheel further back than heretofore, and sufficiently so to balance the rear part of the frame and the raker thereon, when this position of the parts is combined with the sickle back of the axis of motion of the driving-wheel by means of the vibrating power." He also claimed the combination of reel with raker's seat, arranged and located as described, so as to enable the raker to rake and deliver the grain on the ground to the side of the machine, etc.

Continuing the record, Nov. 14, 1848, F. S. Pease, of New York, obtained a patent on a combination of levers with rake for operating the latter. On Nov. 21, same year, Goble and Stuart patented a rotary rake which was to pass horizontally across platform, and was "given an unequal motion for the purpose of raking the cut grain in an effectual manner," and Daniel Cushing, of Aurora, Ill., same date, on revolving rakes.

January 16, 1849, Oliver Barr, of Aurora, Ill., patented a revolving rake and an inclined platform with a sort of trap door for grain to fall through—a kind of dropper. Jas. L. and H. K. Fountain, of Rockford, Ill., May 15, were allowed a claim for "giving to a vibrating blade a compound transverse and horizontal cut by combining it with stationary teeth or a reel." The old "Fountain," as after improved, was a popular machine in its day. A. J. Purviance, of Ohio, May 22, obtained a patent for constructing the platform separate from the other framework, so as to convert the machine easily into a mower or reaper as required. This was an important feature and marked the beginning of practical combined machines. On June 12 a very important patent was granted to Nelson Platt, of Ottawa, Ill., which was assigned to Seymour & Morgan. This was the first of the sweep-rake system which afterward became so popular. The rake swept the grain off in gavels at right angles to the path of the machine. J. J. and H. F. Mann, of Indiana, June 19, patented a self-rake consisting of endless bands, which delivered the grain into a receiver, whence it was discharged by an attendant upon the ground in gavels. The Manns were ingenious and worthy inventors, but unfortunate as manufacturers. A few other patents were granted during the year, but not of any particular consequence.

Whoever has followed the narrative thus far, or will take the trouble to trace the matter out for himself in the patent records, cannot fail to see that a practical reaper was produced by degrees; that one invented a machine having, perhaps, but a single useful feature; his machine died, but this feature lived. Another did likewise, and still another brought out what may have given much promise, but, containing nothing necessary to conceptions following, dropped out of the way. And so as the years rolled along the useful features became massed, until practical machines contained them all. He will find that the successful reaper was invented not by one man, but by many.

The twig planted by British inventors, nourished and intelligently cultivated by practical American genius, had in 1850 become a well-rooted,

vigorous sapling; thereafter it grew rapidly, putting forth limbs and branches in various directions. As soon as it had been demonstrated that grain could be successfully harvested by machinery, inventors directed their attention to its delivery, to provide mechanical methods for getting it off the reaper and in the best possible shape for binding, and so the various self-rakes and droppers were invented. The idea was not new, for it will be remembered that some of the earliest and crudest reapers had self-raking devices attached, but nothing came of them, naturally enough, as such attachments could not be of any value so long as the foundations upon which they must rest were not fixed. The reapers which must bear them had not been established.

Heretofore so few patents, comparatively, had been granted that it has been possible, even in this brief review, to mention all which were of any special importance, or were steps in development; but from 1850 onward they increased so rapidly and became so complicated and intermixed that it will be impossible to notice any more than such as seem to have been the beginning of certain systems or classes of reaping machines. Even this is a difficult undertaking, to determine the bearings of patents upon machines, for the former are usually but skeletons, and one may easily fail to see the completed form which they were intended to bear.

The year 1850 was not prolific in new features for reapers. J. L. Harde-man obtained a patent, Aug. 20, for a platform guiding-board, in connection with an automatic discharging mechanism. It was afterward assigned and re-issued to Wm. N. Whitely, of Springfield, Ohio, and was merged in the Champion system. E. Danford, of Geneva, Ill., Sept. 17, patented improvements on a double sickle. He made a fair machine out of this old idea. As a mower it was one of the best in its time.

In 1851, Palmer & Williams obtained a patent, July 1, for their sweep-rake and quadrant platform. Assigned to Seymour & Morgan, of Brockport, N. Y., it entered into their system of self-rakes. July 8, Wm. H. Seymour patented improvements on a self-rake. These were the foundation patents of the celebrated self-raker known as the "New Yorker," as manufactured by Seymour & Morgan. John H. Manny, of Waddam's Grove, Ill., Sept. 23, obtained a patent for hanging the cutter-bar to the side of a triangular frame, so that neither end could sag; also for forker's stand back of outer end of platform. This was an important invention, and laid the foundations of the immense reaper business of Rockford, Ill., where Manny came in 1853, and subsequently went into partnership with Wait and Sylvester Talcott. Later, Ralph Emerson and Jesse Blinn entered the firm, which was known as Manny & Co., and after Manny's death as Talcott, Emerson & Co. Manny was a prolific inventor (the same may be said of the Manny family), and his early death was unquestionably a great loss to progress. His machine was for a time built by Walter A. Wood. It was one of the earliest of successful combined machines.

In 1852, B. Densmore, of New York, obtained a patent, Feb. 10, for a hanging drive-wheel in supplementary frame, hinged to and outside of the main frame, etc. It was assigned to D. M. Osborne and W. A. Kirby. R. T. Osgood, of Maine, obtained a patent, Feb. 17, assigned to and liberally

re-issued by Cyrenus Wheeler, of Poplar Ridge, N. Y., for independent driving and supporting wheels on a common axle, carrying a rectangular main frame between them on the axle; also providing each drive-wheel with ratchet-wheel and pawl, for the purpose so well known. This was one of the base patents on the old "Cayuga Chief" and other such machines, and so was that granted to E. Forbush, July 20, which also went to Mr. Wheeler. It covered the rake, supported by pivoted connection in the rear of the drive-wheel axis, sweeping over the platform and delivering grain to the rear of the main frame. J. S. & D. Lake, same date, obtained a patent for flexible bar devices, assigned to and re-issued extensively by Jas. Saxton, of Canton, Ohio. W. H. Seymour, Dec. 14, obtained a patent for raker's stand on their old "New Yorker," and supplementary metallic frame for gearing. Jearum Atkins, Chelsea, Ill., patented, Dec. 21, his automatic self-rake, which was truly an automaton. It picked up the grain, turned round and laid it off. It was a striking sight in the field, worked well and had large sale for two or three years, but 1857, with its heavy, tangled grain and financial troubles, wrecked both machine and manufacturers.

In 1853, Thos. D. Burrall, of New York, patented, April 5, an additional apron to platform, to convert rear-discharge into side-discharge. It was re-issued for much more. J. H. Manny, April 19, patented cutter-fingers, and June 21, a sickle. Philo Sylla and Augustus Adams, of Elgin, Ill., Sept. 20, obtained a patent for a jointed bar. They assigned to C. Aultman, of Canton, Ohio, who re-issued it extensively, and it became one in the Buckeye system. W. & T. Schnebley, New York, Dec. 20, patented a peculiar self-rake.

In 1854, A. J. Cook, of Ohio, patented, March 28, a reel-rake, sweeping backward, assigned to C. Wheeler. George Esterly, of Wisconsin, obtained a patent, June 27, on construction of sickle, and a sort of plow track-clearer for divider. Abner Whitely, Aug. 22, obtained a patent for a conical track-clearer, and Sept. 19, for suspending rake to one of the reel-blades, a very important patent. He invented many valuable devices. C. Wheeler, Dec. 5, patented a hanging finger-bar. W. F. Ketchum, assignor to R. L. Howard, Buffalo, N. Y., Dec. 19, patented a segmental rim for drive-wheel, to be used off or on in reaping or mowing. Many will remember this old Howard machine. Ketchum was a versatile inventor, the pioneer in mowers, and he applied his genius in every direction. He died in the harness.

In 1855, J. E. Newcomb, on Jan. 9, obtained a patent for a dropper and other devices, assigned to J. F. Seiberling, Akron, Ohio, who was the acknowledged head of the dropper system. Cyrenus Wheeler, Feb. 6, obtained a patent for a combination of a hinged finger-beam and a side-delivery platform. Mr. Wheeler was a prolific and thoroughly practical inventor. The old "Cayuga Chief" was built under his patents principally—in fact, he was one of the chiefs in the two-wheel jointed-bar fraternity, and his works live. Walter A. Wood, Hoosick Falls, N. Y., March 25, obtained a patent for giving the inside of the grain-wheel a conical shape for track-clearing, and for improvements on platform. Moses G. Hubbard, New York, June 4, obtained a patent for an angle iron bar. Hubbard invented

numerous devices and can be followed all through this department in the patent office. J. Richardson obtained a patent, June 19, for a self-rake, afterward assigned to Walter A. Wood. J. E. Heath, of Ohio, Sept. 11, obtained a patent for a cam gear in center of drive-wheel.

In 1856, the patent of Owen Dorsey, of Maryland, March 4, was an important one for a continuously revolving reel raking device, "the rakes of which rise and fall as they rotate, and as they approach the front part of the platform descend to the level of the latter and sweep over it, raking the cut grain therefrom, and then rise at the discharge end of the platform out of the way." This was a very valuable invention. At first the driver could not ride, but this difficulty was obviated by the T. Whitenack patent of Feb. 5, 1861, and by several others. Cornelius Aultman and Lewis Miller, assignors to Ball, Aultman & Co., Canton, Ohio, patented, June 17, a double rule joint or double-jointed coupling for finger-bar machine. Patents were issued to M. G. Hubbard, Sept. 2, for his self-rake; and the same date to Wm. A. Kirby, for drive-wheel having no outer frame support, for the construction of his two-part frame inside of drive-wheel, and for hinged lever seat. Pells Manny, of Illinois, Oct. 21, obtained two patents for the construction of sickles and stirrup brace for finger-bar. Wm. N. Whitely, of Springfield, Ohio, Nov. 25, covered improvement on his self-rake for balancing by connecting driver's seat with front end of frame, and also for controlling the rake.

In 1857, D. M. Osborne and W. A. Kirby, assignees of W. Mulley, Feb. 10, secured a patent covering a reel support on single post, a feature of the Kirby. Walter A. Wood, same date, obtained two patents for raker's seat and for shoe track-clearer. George Esterly, March 24, covered leading trucks for his big wheel, single gear machine. Ralph Emerson, of Rockford, Ill., May 26, patented an improvement on tongue and castor wheel for Manny machine; and John P. Manny, July 14, an improvement on self-rake. C. P. Gronberg, of Geneva, Ill., Dec. 1, secured a patent for a peculiar raking device. Gronberg was an inventor of merit, but he was unfortunate in his undertakings. E. Ball, of Canton, Ohio, same date, obtained a patent for holding up hinged cutter-bar for moving, etc., and for several other devices pertaining to the Ball machine. Mr. Ball was one of the pioneers in the two-wheeled jointed-bar system. He was a good man and a thoroughly excellent manufacturer, but became involved in business and died soon after.

In 1858, J. L. Fountain, of Rockford, Ill., patented, Jan. 12, a self-rake. F. Nishwitz, of New York, Feb. 16, patented a lever pawl and chain for raising floating cutter-bar. It is said that Nishwitz was one of the first to construct a practical jointed-bar machine, but was too poor to go on with it. Geo. S. Curtis, of Chicago, patented, Feb. 28, his cam reaper. Lewis Miller, Canton, Ohio, May 4, obtained a patent relating to front-cut, jointed bar machines, for hinging, raising and folding cutter-bar on the "Buckeye," and, same date, on combining reel with hinged platform so as to preserve their relations when undulating. These were important patents. I. J. W. S. and C. H. McCormick, May 11, secured a patent for construction of finger-bar, liberally re-issued afterward; John P. Manny, July 6, four

patents on his machine; C. H. McCormick, Sept. 21, on shape of guard fingers; McClintock Young, Maryland, same date, who then began the foundation of what was known afterward as McCormick's self-rake; Jas. S. Marsh, Lewisburg, Pa., Nov. 16, on lever and adjustment of finger-bar.

In 1859, Wm. N. and Andrew Whitely, obtained a patent, Jan. 18, on guards and sections; J. S. and H. R. Russell, of Maryland, March 29, for improvements on reel rake, assigned to J. F. Seiberling, and forming part of his system. S. A. Lindsay, of Maryland, Aug. 2, for a reel rake arranged to accommodate itself to a hinged platform, also covering the important combination of a quadrant platform, hinged finger-beam and frame supported by two wheels; Obed Hussey, Aug. 23, for raising and lowering device for his machine, his last patent; E. Ball, Oct. 18, drag-bar and swiveled coupling-arm and finger-bar; Wm. A. Kirby, Nov. 15, location of raker's seat on Kirby reaper.

In 1860, E. Ball and M. E. Ballard, March 20, secured a patent for steel spring cap-plate with heel of cutter-bar and shoe; Lewis E. Reese, New Jersey, April 10, for improvement on revolving reel-rake to enable driver to ride comfortably; F. H. Manny, of Illinois, Aug. 20, for hinged cap and shoe; Walter A. Wood, Sept. 11, on his self-rake or automatic fork. McClintock Young, Sept. 18, obtained a valuable patent for "combination of a revolving reel shaft carrying diverging reel gatherers supported at one end only, the fixed double-walled cam and the rake revolving around said shaft, and oscillating on an axis both eccentric and transverse to said shaft with a counterpoise to equalize the movement of said rake;" re-issued after assignment to the McCormicks. This, combined with other devices, became the McCormick self-rake.

In 1861, D. S. Morgan obtained a patent, Jan. 22, for reel support; J. S. Marsh, May 21, for rake; Walter A. Wood, Nov. 19, covering improvements on his well-known self-rake now practically invented; D. L. Emerson, of Rockford, Ill., Dec. 10, on combination of wheel and divider, one of his many patents.

In 1862, Ralph Emerson, on Jan. 14, obtained a patent relating to a lever-bar and attachment of guards; Samuel Johnson, Nov. 4, for his sweep-rake, mounted directly and wholly upon a suspended hinged joint finger-beam.

In 1863, a patent was issued to James S. Marsh, Feb. 10, for revolving rake and reel, the arms of which are hinged to the revolving head independent of each other, etc., and to Reuben Hoffheins, Pennsylvania, Nov. 3, for self-rake mounted on finger-beam and rotating on a vertical axis, or nearly so.

In 1864 the most important patent issued on reapers was to O. H. Burdick, Jan. 7, for his rake, which was one of the D. M. Osborne & Co. system.

In 1865, a patent was issued to Samuel Johnston, Feb. 7, assignor to himself and R. L. Howard, of Buffalo, N. Y., for his celebrated reel rake. In this all the arms carried rakes, and were each hinged independently and all controlled by the driver; to John A. Dodge, of Auburn, N. Y., May 23, for construction of main gearing, etc.; to Wm. N. Whitely, Aug. 29, for Champion self-rake; to Lewis Miller, of Ohio, Nov. 21, for his well-known

table-rake, i. e., table upon which grain falls, and revolving rake beneath, to sweep it off to the side and rear; to A. J. Manny (another Manny in the field), Nov. 28, for hinged cutting apparatus, and to Wm. N. Whitely, Dec. 5, for improvements on drag-bar.

In 1866, three patents were issued to Wm. N. Whitely, Jan. 30, for improvements on the Champion; one to O. H. Burdick, assignor to himself and D. M. Osborne, Feb. 27, for rake and reel; one to Adam R. Reese, of New Jersey, May 1, for revolving rake in connection with driver's seat, and one to Wm. N. Whitely, Aug. 21, for reel and rake independent of reel for hinged platform.

In 1867, a patent was issued to L. J. McCormick, and L. Erpelding, Jan. 15, for supplementary frame, hinged finger-beam worked by lifting and locking levers; and to Amos Rank, Feb. 12, for longitudinal drag-bar and other improvements on the "Etna" machine.

In 1868, Jas. S. Marsh obtained a patent, Jan. 21, for devices on his rake; Rufus Dutton, Feb. 11, five patents on reaper construction; C. Wheeler, April 21, two patents on rake and on machine; G. W. N. Yost, of Corry, Pa., June 9, five patents on devices pertaining to the "Climax" machine, mowing and reaping.

In 1869, John Barnes, of Rockford, Ill., obtained, Jan. 12, two patents on his self-rake machine; Amos Rank, of Ohio, May 4, one covering devices for dropper; Eph. Myers, of Maryland, Dec. 4, for dropper; T. F. Lippincott, of Pennsylvania, Dec. 21, for dropper; and L. J. McCormick, L. Erpelding and Wm. R. Baker, for over-hung reel in connection with rotating turning rake mounted on the finger-beam.

The inventions that have been noticed in the foregoing bring us down to 1870, to the time when foundation features of reapers had all been invented and substantially perfected. It is therefore unnecessary to pursue the subject farther, especially since the reaper had by this time begun to beat a retreat in the harvest fields of the west before the advance guard of modern harvesting machinery.

CHAPTER VII.

Harvesters

SINCE the advent of the Marsh harvester the term "harvester" has been applied almost exclusively to the particular kind of machines which carry binders, whether men to bind by hand, or automatic binders, substituted for the men, to bind mechanically. But this use of the term is arbitrary and narrow; it should take in strippers, headers and combined harvesters and threshers; and it will at least be better for our purpose to give it a wider meaning.

[The first harvester, then, of which we have any certain record was the often mentioned Gallic stripping header described by Pliny in the first century and by Palladius in the fourth. It appears to have been uninterruptedly used for several centuries, and unquestionably it had not been in use that long without having been more or less improved, for the people who could invent and construct such a machine would surely improve upon it, and they would also invent others of like character. There is no doubt that various reaping and harvesting machines were used by the ancients of which we have no record, principally because agricultural pursuits were not honored and historians gave their attention chiefly to matters of government and war.] But had the Alexandrian library and museum escaped destruction, we should have had descriptions of many strange devices and methods, some of great value, that have been lost to the world and never yet found by our wisest men or most skillful inventors.

This machine of the Gauls had lance-shaped knives, or teeth, with sharpened sides, projecting forward from a bar, like guard-teeth, but set close together and forming a sort of comb. As it was pushed forward the stalks next the head came between these sharp teeth and were cut or stripped off into a box attached to and behind the cutter-bar, and carried by two wheels. When the box was filled with heads, the machine was driven in and emptied. This is the way in which it is supposed that it was worked, and the illustration is the generally accepted representation of it as roughly reconstructed from the old Latin descriptions.

This harvesting machine has not received the attention it deserves. It was the prototype of all headers and strippers. Its distinctive features are shown in several modern inventions in this class, and the Australian strippers of to-day, less their threshing attachments, are mere copies. Undoubtedly it was found to be exactly the thing required for such grain as was raised upon the plains of Gaul, just as in Australia it is peculiarly adapted to the requirements there.

The discussion of this machine in England a hundred years ago, growing out of the publication of the descriptions given by both Pliny and Pal-

ladius, and instigated also by a premium offered by the Society for the Encouragement of Arts, Manufactures and Commerce, brought out in 1786 the machine "for rippling corn" (grain) of Wm. Pitt, of Pendeford. It was an attempted improvement on the ancient one just described. The "rippling cylinder"—the first suggestion of a reel—took off and delivered the heads into a box behind the strippers. Mr. Pitt says: "The grain thus collected, in a short time of the most favorable weather the straw may be cut and collected at leisure, and with less regard to rain or showers than is necessarily the case in the common mode of harvesting." So here, after nearly 1,800 years, we have the second header, according to the records. What held the world back during this long interval? A successful clover header made in 1807 had exactly the Gallic cutting apparatus, and it was not unlike a modern popular American clover header. Nothing further seemed to have been done on this class of machines by British inventors for a long time; so we may now take up American inventions.

Samuel Lane, of Hallowell, Maine, Aug. 8, 1828, obtained a patent for a combined harvester and thresher. It was an ingenious machine, but very complex. There is no record of its use, and it probably never went beyond a patent. It was, however, the first machine of record covering these principles.

D. Ashmore and J. Peck, of Tennessee, Sept. 18, 1835, patented a header with cutters like those of the old Gallic machine; but they added fingers (not cutting) projecting beyond the cutters, "the better to guide the heads to the knives," and also a reel, or "open cylinder," carrying knives which in revolving came nearly into contact with the row of fixed lance-shaped knives or strippers. It resembled somewhat the first modern harvesting machine—that of Wm. Pitt, in 1786, before described. They claimed "the principle of the governor of the rudder to give direction to the machine." Bell also, in 1826, had a hand lever for directing his reaper, and both were operated from behind.

E. Briggs and C. G. Carpenter, Feb. 6, 1836, patented a machine that ran on four wheels, like wagon wheels, and depended upon the traction of the two hind wheels to carry both the cutting and threshing apparatus. They claimed broadly "the manner and principle of applying the power of a team to cutting, threshing and cleaning grain by moving forward the machine," etc., but this was not a new idea.

June 28, 1836, H. Moore and J. Hascall, of Kalamazoo, Mich., patented a machine for harvesting, threshing, cleaning and bagging grain which deserves particular mention because of its many ingenious devices, its comparative success and the notoriety it gained on account of the unsuccessful attempt made in 1853 to get the patent extended through Congress. This machine in the hands of its ingenious proprietors would have proved a success had they been able to invent something to regulate the weather in this western country. But the maxim, old at the time of Pliny and quoted by him, that "'tis better to reap two days too soon than two days too late," has always been in the way of such harvesters, in this climate at any rate, for here the proper time to cut is not the proper time to thresh grain. This machine had a reciprocating sickle, working across fixed guard-teeth, with

a "rippling cylinder," studded with rows of small spikes, acting as a gathering reel over the sickle and delivering the grain upon an endless apron behind, which carried the heads back to a threshing cylinder. Back of the latter was a traveling sieve, or riddle, which carried the coarser refuse over to fall upon the ground, while the threshed grain and chaff, sifting through the sieve, was winnowed by a fan blast, then elevated and delivered through a spout into bags.

The next machine of this class was invented by Alfred Churchill, of Geneva, Ill., and patented March 16, 1841. It was constructed on an entirely different principle from the foregoing, but it does not appear that it ever went into use.

May 14, 1841, D. A. Church, of New York, obtained a patent for still another harvester and thresher. The peculiar feature of this was that it had the old Gallic comb cutters, improved by having a spring attached to keep them up to the gathering wheel, which latter operated, like the old "rippling cylinder," to force the heads against and between the knives. The heads, after being dissevered, were carried back, threshed and delivered in substantially the usual manner. Some of these machines were manufactured for the market, and gave, it is claimed, good satisfaction. In 1847, Feb. 13, Mr. Church, in connection with L. H. Overt, of New York, and W. W. and O. F. Willoughby, of Chicago, patented certain improvements in the construction of a separator, consisting of "separate combs turning on pivots in endless chains," etc. Mr. Church died about this time. E. C. West, of Vermont, June 25, 1845, patented a sort of revolving cradle apparatus for cutting, with apron to receive grain and to deliver to threshers. March 7, 1846, J. Darling, of Michigan, patented improvements upon carrying platforms formed of toothed slats and moving as described to convey grain to the thresher. He also claimed a mode of steering by pivot wheels. Clinton Foster, of Indiana, Jan. 1, 1847, patented devices relating to machines of this description. Mr. Foster was a son of Judge Foster, of Hamilton county, Ohio, on whose farm Capt. Hussey tried his machine in 1832. He got into a way of inventing in consequence, and did some creditable work on harvesting machines.

In connection with the subject of harvesters and threshers, considerable interest attaches to the invention of a Mr. Ridley, of South Australia, in 1845. It is described as follows: "It is something like a cart pushed forward by two horses instead of being drawn. In front of the machine is a very large steel comb, which, as the machine advances, seizes the straw as a comb seizes the hair, that is, the grain was combed out, the kernels falling into the box, or the heads were dragged up to a cylinder playing over the comb and threshed out. The winnowing, it is said, was done by the "draft raised by the motion of the machine." The publication of this invention occasioned considerable discussion, and the English papers were very indignant that the Yankees should claim that they had any such machines here. Even Her Majesty and Prince Albert became interested, and "were pleased to express to Mr. Ridley their admiration of the value and importance of his invention." Inasmuch as our patent office records show several elaborate harvesting and threshing machines prior to this—Moore & Hascall having

used theirs some eight or nine years before—the indignation over “Yankee assumption” manifested by our British cousins was certainly uncalled for, and somewhat ridiculous, considering the character of the invention. Even in their own dominions, and much nearer home, a machine for harvesting and threshing had been constructed and used some time during the “thirties” by a man named Williams, in Canada, which might have been quoted against this Australian device, both on the score of ingenuity and priority.

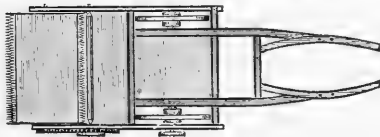
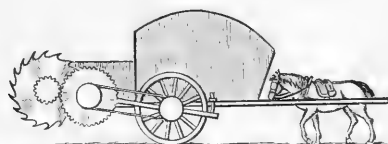
George Esterly, of Wisconsin, Oct. 2, 1844, obtained a patent on his header or harvester. “The box which receives the grain is supported on wheels and is provided with a permanent knife in front, and a rotating reel with beaters, which carry the heads of grain up against the permanent knife to cut them off.” By a lever the attendant adjusted the cutter and reel to the varying height of the grain. Esterly’s machine was manufactured on a considerable scale and did good work. The illustration shows the first one made and used in 1844. Afterward he added a canvas apron to carry the heads back, and another to deliver to the side and into wagons; besides making improvements in other respects. It was a leading machine back in the “forties.”

March 27, 1849, Jonathan Haines, of Illinois, patented his celebrated header, known throughout the west generally some years since, and in California still, as “Haines Illinois harvester.” Large numbers of them have been built, and they were thoroughly practical heading harvesters. His claim was on “suspending the frame which carries the conveyer reel and cutter, upon the axles of the wheels A, when the frame thus suspended is hinged to the tongue, and rendered capable of being turned upon its bearings, by means of a lever, for the purpose of elevating and depressing the cutter as herein set forth.” It cut a very wide swath in the ordinary manner and harvested rapidly when run to its capacity. The patent was subsequently re-issued so as to cover his devices better.

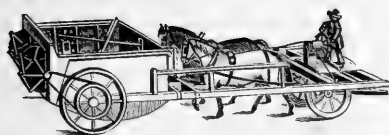
In the summer of 1850 Augustus Adams and J. T. Gifford, of Elgin, Ill., built a machine and made application for patent (which was afterward withdrawn) on “improvements for cutting and gathering grain either by the reaping or heading process.” The cut grain was delivered by means of an endless canvas apron into a receptacle at the side which was like a wagon box and upon wheels, and falling on the floor was lifted therefrom by two or more attendants, riding in the box, and placed upon a table along the outer side, where it was bound. This machine was tried in the harvest of 1850 or 1851 and was probably the first in the field, with men riding thereon, who bound the grain as cut. But Mr. Gifford dying, Mr. Adams connected himself with Philo Sylla, and they began on a machine of a different character, which was patented Sept. 20, 1853. This carried three men upon its platform to bind the grain, which was forked or shoved around to them by a fourth man. A box was attached to receive the sheaves and carry them until enough was collected for a “shock,” when they were dumped upon the stubble. It contained another principle: the finger-bar was hinged to the main frame, allowing it to “vibrate perpendicularly and accommodate itself to uneven ground.” On account of the latter feature, particularly,



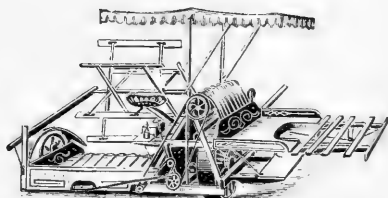
GALLIC STRIPPING HEADER, FIRST CENTURY.



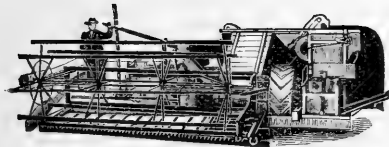
PITTS MACHINE, 1786.



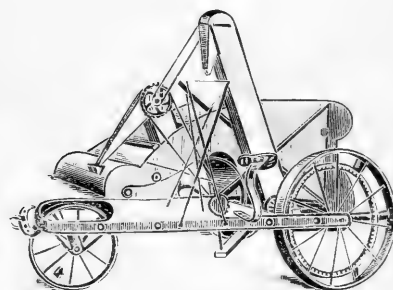
ESTERLY HEADER, 1844.



MARSH HARVESTER, AS BUILT IN 1879.



MODERN CALIFORNIA COMBINED HARVESTER.



AUSTRALIAN "COMBINED" STRIPPING HARVESTER.

the patent was purchased by C. Aultman & Co., to whom it was re-issued in six divisions. Unquestionably it was one of those inventions which set a stake, so to speak; and if the inventors had comprehended all the possibilities of this machine, as well as of the other which they abandoned, and had thoroughly followed them up, they might have reaped great advantages therefrom. But as a harvester, this last carried so many men that it was too heavy and cumbrous, and the facilities for handling the grain were not sufficient to enable the operator to take care of it, especially if heavy or tangled. They built a hundred or more of them and then discontinued.

April 1, 1856, A. Elliott, of California, patented a complicated machine by which grain, after being cut, was formed "into sheaves or bundles, by means of a series of endless bands and rollers having an intermittent motion," which were bound by boys during a stop in the revolution of the compressing apparatus that grasped the bundles. The machine was not practical and it added nothing to progress. Ezra Emmert, Franklin Grove, Ill., Jan. 19, 1858, patented a machine with an apron delivery, his claim being for the "peculiarly constructed apron *F*, and retaining hooks *J, J*, in combination with binding hook *L* and platform *M*, for purposes specified." This was never put upon the market. Possibly both these latter machines should have been classed with binders on account of their devices for forming bundles, but the tying was done by hand.

We have now traced this class of machines down to the advent of the Marsh harvester, the prototype of all machines which since have carried binders—whether men or automatic machinery substituted in place of men—to bind grain before delivery to the ground. No other harvesting machine before it had lived to establish a general trade. The Haines header made the best record, but it was limited to localities where the climate and conditions might allow its use. At the time the Marsh harvester began seeking a place in the market "reapers"—hand-rakers, self-rakers and droppers—held the trade substantially to the exclusion of any other kind of harvesting machine. So many failures and disappointments had attended the introduction of harvesting machines that a general prejudice existed against anything not strictly a reaper.

This was the condition of the trade when C. W. and W. W. Marsh, of DeKalb county, Ill., invented their harvester and during the years of its development and introduction. They had not the advantage of the earlier inventors for whom there was an open field, and a hungry demand for anything that might cut the grain; but they, and parties interested in them, had to face, with a machine clouded by the failures of others, various excellent reapers backed by established reputations and wealthy proprietors, in full control of the market.

Their original patent was granted Aug. 17, 1858, and their first harvester, built at home, was successfully operated through harvest that year. It has never been changed materially, in principle or form, since; and if the same old machine as used in 1858, and painted as others now are, were seen standing to-day in any field in America, Europe or Australia, with binders' tables off, one familiar with such machines would wonder, as he came forward for a closer inspection, whether it was McCormick's, Wood's or Deering's,

Samuelson's or Hornsby's harvester and binder, and why the binder was not in place.

Its invention was not the result of an accident, but was deliberately studied and worked out on the farm during 1856, 1857 and 1858, and, somewhat like Esterly's header, from practical necessity. The theory of the inventors was that two men might bind the grain cut by a five-foot sickle in ordinary motion, provided it could be delivered to them in the best possible position and condition for binding, and they could have perfect freedom of action. They knew that traps or aids in binding would simply be impediments, and that only a free swing and an open chance at the grain would enable them to handle it; so they arranged the elevated delivery, receptacle and tables, and the platform, with these ends in view, that the operators alternating in their work regularly might have equal advantages and facilities for binding, and that their weight might give necessary traction and balance. This was their original invention, without reference to the original patent, which was misunderstood by the examiner, and botched by Munn & Co, the attorneys who filed the application. The bundle carrier, with its caster wheel, shown in first patent, was, as it proved, an unfortunate afterthought. It was not built with the first machine, and was no more necessary to it than such attachments have been to other harvesters.

The second Marsh harvester was built in Chicago in 1859. It worked admirably through that harvest, and aroused much enthusiasm and courage in the inventors. In 1860 they attempted to put up a dozen at home; but they were fifteen miles from the railroad, the work was partly done in Chicago, partly at De Kalb, and partly at home and around among the blacksmiths. The machines came together badly, and had neither strength nor capacity for the extraordinary weight and height of the grain grown that year, so these failed except one or two, which were patched up and pulled through—but the men handled the grain when it could be gotten to them. This was a serious disaster, and everybody interested in the inventors advised them to give the thing up, except Lewis Steward, of Plano, Ill., who saw one of the 1860 machines work; so they went to Plano, and in connection with Mr. Hollister, a thorough mechanic, built a harvester which, though somewhat imperfect in details, had the required strength, mechanical action, and capacity for all kinds of grain. This was experimented with and improved during the years 1861, 1862 and 1863, and seeming sufficiently practical, the manufacture of harvesters for the market began at Plano in the fall of 1863 by Steward & Marsh. Fifty were begun, only twenty-six being completed, but they gave fair satisfaction in the harvest of 1864, and the balance of them, improved somewhat, were successfully marketed in 1865.

Meantime the Marsh Bros. had become involved through these experimental expenses and losses, and having neither the experience nor the inclination to be manufacturers, but hoping to avoid that necessity, they were induced to sell a third interest in their invention to Champlin & Taylor, a couple of speculators, in connection with whom they made a license for six of the western states to Easter & Gammon, of Chicago, reserving, however, certain rights to themselves and for the Plano shops. About this time, also,

Emerson & Talcott became interested through purchase from Champlin & Taylor. Unfortunately, too many were thus interested, and the machines thereafter were made, not as they should have been during their development—continuously in one shop and by one set of men—but at Plano by Marsh, Steward & Co.; at Beloit, Wis., by Parker & Stone; at Rockford, Ill., by Emerson, Talcott & Co., and at Springfield, Ohio, by Warder, Mitchell & Co. Some in consequence were constructed well, some fairly and some poorly.

The introductory struggle was severe and costly to the inventors and proprietors. On account of its solitary position all others were naturally combined against it. Binders were prejudiced from the start, supposing it would be very hard work, or that the machine in the end might reduce demand for labor in harvest. They had to be coaxed, sometimes specially hired, and generally instructed. Trials were gotten up, and experienced men who could bind alone exhibited their capacity. Even farmers' daughters who had become experts were taken to trials and bound the grain as cut, to show men what they ought to be able to do. And thus the machine steadily gained ground.

From the time of the invention of this machine, until 1871—fourteen years—none like it was on the market, or publicly known except in patents. In 1871 Mr. Ellward had six machines built at Plano—a modification of the Marsh; and about this time W. R. Low got out his machine; which was a change in another direction. Ellward's machine became well known in time as the St. Paul harvester; and Low's, improved by himself and Augustus Adams, as the Low, Adams & French harvester, built by the Sandwich Manufacturing Company. Both these concerns recognized the rights of the inventors, took out licenses and built good machines. Along in 1872 and 1873 other parties began making harvesters, and also experimenting with automatic binders attached—the Wood for instance—as also did the Marsh licensees, at first sending out both the hand and automatic binding attachments, and as the latter became perfected, dropping the former altogether. The McCormicks began putting out harvesters in 1875 and wire binders in 1877, and others came in later.

Thus as the years rolled along hand binding gradually gave place to automatic binding, with wire at first and cord at last; and thus also out of the body of the old Marsh harvester sprang the various harvesters and binders now harvesting grain for the world.

Of straight harvesters—carrying men to bind—there had been made up to and including 1879, over 100,000, of which about two-thirds had been produced by the Marsh combination, and the rest by outsiders.

There seems to be nothing worthy of notice in this line among the patents, during the latter part of 1858 or 1859. In February, 1860, E. Peck, of California, obtained a patent on a header—for improvements in guiding and turning the machine by means of shaft pinion and semicircular rack; B. F. Witt, of Indiana, April 10, 1860, for a harvester which had a supplementary carriage attached with saddles for binders; C. Alvord, of Wisconsin, March 5, 1861, for a harvester which had a reciprocating gavel carrier to deliver gavels alternately at each end of a trough, to be bound, etc.; J. R.

and C. N. Mayberry, of Illinois, Nov. 19, 1861, for improvements in balancing, equalization of draft, and raising and lowering their header. Sept. 16, 1862, Royal Hance, of Illinois, patented a header on which the conveyor was located in front of the drive wheel and the horses were attached to and drew from the front.

C. W. and W. W. Marsh, Jan. 5, 1864, patented improvements on their harvester, for projecting part of the elevator forward the better to carry up butts of grain, etc.; D. J. Marvin, of California, Nov. 15, 1864, obtained a patent for a harvester and thresher, "so pivoting or hanging cutter frame upon the main axle that it can be moved longitudinally and also raised and lowered at pleasure," etc.; J. W. Harvey, of Iowa, Dec. 27, 1864, on an auxiliary concave receiver, gate and gaveling fingers, for seizing the grain to facilitate binding. C. W. and W. W. Marsh, Feb. 14, 1865, received a patent covering scolloped gatherer or hollow inside divider with hinged extension; and J. Seibel, Feb. 21, 1865, on a "push" harvester. C. Denton, of Illinois, Oct. 9, 1866, patented his header, the improvements being chiefly upon devices for raising and lowering the cutting apparatus and in attaching the spout, etc. J. Emery, of Iowa, June 25, 1867, obtained a patent for rotating binders' station in connection with a harvester. This idea was further developed by J. D. Easter & Co., some years after. J. Lancaster, of Maryland, Aug. 29, 1867, patented for a harvester a rake and fender, in connection with binders' platform in rear of grain platform. C. W. and W. W. Marsh, Nov. 12, 1867, secured a patent on a single driving belt for harvester platform and elevator with adjustable tightening pulley, etc.; J. Underwood, of Iowa, June 9, 1868, patented his harvester in which "the grain as it is felled by the cutter is moved backward and upward and delivered upon a platform upon which it is moved laterally toward the inner side to a position where it may be conveniently bound by hand"—the grain being moved by a reciprocating follower. C. Denton, of Illinois, June 30, 1868, obtained a patent on spout and arrangement for driving sickles for his header; C. W. and B. F. Witt, of Indiana, Aug. 4, 1868, on a tipping rake to receive grain and deliver to binder, and binder table in combination with tipping rake; M. Vanderpool, Oregon, Oct. 6, 1868, on peculiar harvester and thresher, with spiral reel, obliquely ribbed drum, ribbed concaves and spiked drums, etc.; L. B. Lathrop, California, May 25, 1869, on a harvester and thresher with too many devices to describe herein; July 13, 1869, E. Emmert, of Illinois, on "the combination of a continuously moving carrier with an oscillating stop rake, to intermit the delivery of grain to the binder" and W. G. and L. T. Davis, Oregon, Nov. 16, 1869, "a combined header and thresher, constructed substantially as described, and having arrangements for attaching teams both at front and rear substantially as set forth."

AUSTRALIAN STRIPPING HARVESTERS.

The first machine of record on this plan as used in Australia was the one brought out by Mr. Ridley in 1845, already described. Stripping harvesters, however, which are now so extensively used in many portions of Australasia, where climate and grain may be adaptable, have been of recent development. All seem to have the steel comb stripping arrangement of the old Gallic machine so frequently referred to—with the "rippling cylin-

der" added first by Mr. Pitt in 1786, but so set as to thresh out the grain from the heads, which threshed grain from ordinary strippers, to be cleaned by "winnowers"—as separate machines, either by following or receiving the uncleaned grain brought to them. The combined stripper and winnower is called by Australians a "combined harvester." The following is a description of McKay's:

"The front portion is made as the ordinary stripper, the drum driving the stripped grain up over the apron and into a hopper, under which the riddles are suspended on self-adjusting rollers, by the action of which they are always retained in a horizontal position, which is necessary for the proper cleaning of the grain. The blast is derived from a fan placed at bottom of the back part of the machine, the current of air from which is directed through the riddles, and is quite sufficient to effectually remove all chaff, etc., from the grain. The power of the blast can be regulated by the driver as may be required, and the riddles have a vibratory motion imparted to them, as in the ordinary winnower. The chaff is carried forward into a box placed behind the drum, thus preventing its escape over the field, which is an objection urged against other harvesters. When filled the box can be instantly emptied of its contents by the man moving a lever and the chaff dropped in a heap. All whiteheads are returned by an elevator to the drum to be re-threshed. The grain, after passing through the riddles, falls on a screen in the usual manner, and is conveyed to an elevator placed on the rear side of the machine. This elevates it into a hopper from which the bags are filled. The bag stands on the platform close beside the driver's seat, and thus all the principal operations are under his eye. The grain is run into the bag through a tube. To overcome the difficulty hitherto felt of sewing the bags a very simple device has been hit upon. The bags are sewn before they are taken to the field, all but about three inches of the corner. The grain is run into this opening, and as the bag is attached to a shaking lever it can be completely filled. In the sewing of the bags a length of twine is left at the corner sufficient to secure it. Thus when the bag is full, the driver has merely to twist the string around a time or two (an operation only requiring a few seconds), and the bag is then disposed of in a fit condition for market. For the greater convenience of gathering they may be dropped two at a time, there being sufficient room on the platform to carry two or more bags as occasion may require."

THE CALIFORNIA COMBINED HARVESTER.

The climate of California has proved favorable to the development of the "combined harvester," and during the past ten years many styles of this eminently labor-saving implement have been perfected and manufactured for use in the great wheat ranches west of the Rockies. The invention of the main features of this machine was recorded in the patent office before any hand-raking reaper had been made practical for the market, and it seemed at first as though it would come into general use. But climatic conditions in the central and eastern states are such that wheat must be cut before it is dry enough to be threshed. On the Pacific coast it seldom or never rains during the harvest season, and the straw stands straight and stiff.

The combined harvester, as generally used on the Coast, is practically a combination of a header, cutting 16 to 40 feet, with a threshing cylinder and separator. It is drawn or propelled either by animals or by a traction engine. Eighteen to twenty-four or more horses or mules are required to handle one of the more common size, or a traction engine developing 40 to 60-horse power. A machine of ordinary capacity, requiring three or sometimes four men to operate it, will cut 50 acres per day, leaving the grain in bags, which are dropped from the machine, to be picked up by wagons.

CHAPTER VIII.

Automatic Binders.

PROGRESS is made by steps, not by leaps, but always there were men whose ideas projected far in advance of their times. Inventors and reformers usually attempt to cover too much, in view of conditions current; and their efforts fail because people, although generally disposed to take in improved methods and theories if given regularly and in small doses, will reject the same altogether if offered in mass. They forget that the world was not made in a day—that its rock had to be covered with mould before it could take on its dress of ornamented green. Radicals are not philosophic architects; they too often build superstructures before the foundations have been laid. Their ambition is too vaulting and too crisp; they fail because they

"Soar too high and fall for lack of moisture quite a-dry,"

as Byron wrote of Bob Southey. Still these Excelsiors are necessary factors in progress. Though they may flash up like rockets and come down like the sticks, their short illuminations usually point out roads which others following may pursue more surely and successfully. Many machines and many theories have failed because their projectors built up airy edifices upon insufficient foundations; but some have failed simply because the people were not ready or fitted to receive them.

Inventors of harvesting machinery dreamed over self-raking devices, and wandered among the mazy complications of combined harvesters and threshers, before any one had produced a practical cutting apparatus. Ogle and Brown got out early a promising reaper, but the people broke it up and mobbed them. These all failed, but they pointed out the road which others took in due time.

Inventors were seeking after automatic binders—the climax of harvesting machinery—before a practical reaper had been fully found. They also were in advance of the times and conditions, and could not have succeeded because practical reaping machines had first to be fully developed, generally introduced, and made thoroughly familiar to farmers. Hence all the earlier efforts failed, though some of them might have been crowned with success had the conditions been favorable.

The invention and development of self-binders may be divided into three eras, the first comprising the earlier efforts, which were confined chiefly to the adaptation of binding devices to reapers—some as attachments operated by attendants, and some complete and automatic throughout, but all, substantially, upon what is called the "low down" theory. Every kind possible of material was used and every conceivable form of binder was tried, but all failed to the extent that none established itself in the market. The second

era began with the adaptation of self-binders to the Marsh harvester and runs through the various stages of development in wire and twine binders, and down to the time of the third, or current era, wherein all useless and impracticable devices have been eliminated, all material for bands has given place to twine, and all machines upon the market, with one or two exceptions, are substantially alike in form and general principles.

John E. Heath, of Warren, Ohio, was the first of record to attempt to bind grain by machinery, and his was a twine or cord binder. His patent was dated July 22, 1850, and the claims are as follows:

"First. Gathering the grain and compressing it into a sheaf substantially as herein set forth, by means of the rake and standard

"Second. Carrying the cord around the sheaf and holding the latter until the band is tied by means of the curved lever *h*, and toothed arm *g*, substantially as herein described.

"Third. The employment of split thimble and sliding hook to aid in tying the band.

"Fourth. Alternating the rake to gather the grain and compress the sheaf, by means of the spring, strap and drum, substantially as herein set forth."

"Fifth. Bridging the space through which the bound sheaf drops, to support the grain while it is being gathered, substantially as herein set forth."

But little is known of Heath's binder except from his patent. It is said that he built several machines and that they operated fairly well for a first effort. They must have given good promise, as he sold the right to the southern portion of Illinois for \$4,000 to S. H. Tudor in 1851, and made other transfers on record. He was born in Tolland, Conn., March 19, 1806. At the age of twelve he made ax-helves and ox-yokes by machinery. He removed to Ohio at an early date and there conceived the idea of a binder. Somewhere about 1840 he took first premium for his mower at the state fair in Chicago, and in 1855 he was awarded the \$1,000 grand gold medal offered by the Massachusetts Agricultural Society for the best mowing machine. He died at Prairie City, Ill., July 16, 1881.

The next patent for a binder was granted to Watson, Renwick & Watson, May 13, 1851. This patent is a curiosity and a study. The specification is exceedingly long, with many drawings, and it is reinforced by two or three pages of modifications, the inventors evidently intending to cover every form of binding device that they could think of. Their first claim reads as follows: "The method of raking and binding grain with one operation, by the mechanism herein specified or its equivalent." That was comprehensive and broad enough surely. The next claim related to the self-rake, which was a toothed arrangement, sweeping the grain lengthwise of the platform and delivering to the binder located at the end. Their claim reads: "The method of adapting the binding apparatus to the length of the cut grain; either by moving the cutting apparatus backward and forward to accommodate the binder, or by moving the binder nearer to or further from the front of the platform in such a manner that the sheaf may be bound near the middle of its length," etc. The next claim covers the automatic prin-

ciple, the parts "acting in connection and automatically, by motion derived from or dependent upon the movement of the machine," etc.; and the fifth covers the cord arm, which, with the cord or twine, encircled the bundle, the cord paying off from a reel and through the end of the arm in the usual way, substantially. It shows two ways of fastening and band; one by passing the end of the cord through an eyelet which is closed down upon them by a blow from a plunger, the other by making a knot. Apparently everything necessary in the way of a binder was thought of and much more, but it did not get beyond experiments.

P. H. Watson and E. S. Renwick, two of the three inventors whose patent we have just described, were granted another patent on binders Dec. 6, 1853. This is an exceedingly complicated invention, but its general form more nearly approaches the modern harvester and binder than any other of these early inventions.

The grain was to fall upon revolving bands, and was to be carried up by a series of such bands into a sort of crib, in which it was to be bound and from which it was to be delivered upon the ground. The binding was to be done with cord or twine, tied with a knot, and all the movements were automatic. This also had several pages of variations and modifications added. It was a mass of ingenious but impracticable devices, and the patent is well known in the courts, as it has been a stumbling block in the way of later inventors. Mr. Watson became a noted patent lawyer, was assistant secretary of war under Stanton, and afterward president of the Erie railway.

These first three efforts were made with cord or twine as the material for binding. The next patent on binders was granted to J. E. Nesen, of New York, December 13, 1853. He employed an endless platform apron, having an intermittent motion for carrying the grain to the binder hooks which compressed into bundles that were bound with straw bands. It was not an automatic binder, of course.

Geo. W. N. Yost, of Mississippi, Jan. 1, 1856, obtained a patent on a machine for binding with a cord band, cut to right length, with a knot tied in one end. This knotted end was placed in a notch and the other end went somewhere. A gathering and compressing apparatus swept along the platform, forming a bundle, around which the band was brought, when its ends were tied by an attendant.

W. E. Pagett, of Virginia, July 29, 1856, used metal strips prepared with hooks and rings in combination with slide and "way" by which the bands were put around the bundle and hooked together.

These three last described were not automatic and they added nothing to advancement. The next machine showed decided progress. This was the invention of C. A. McPhitridge, of St. Louis, Mo., by whom it was patented Nov. 18, 1856. The theory of it is very well given in his claim, as follows: "The combination of the reciprocating arm *G*, with spring pliers *G* attached, with stationary arm *M*, revolving twister *r*, cutting plate *q*, friction brake *q*, spring *u*, and movable plate *o*; when the same are constructed and arranged to operate in relation to each other and the main frame and driving wheel, for the purpose of binding grain from a continuous

coil of wire," etc. He was the first to bind with wire, which was coiled upon a reel and delivered to the reciprocating binding arm. The latter performed its functions substantially like the modern arm, and the wire received the ordinary twist and cut.

During the year 1857 four binder patents were issued, as follows: April 28, to J. F. Barrett, New York; May 5, to H. Kellogg, Marengo, Ill.; Sept. 22, to J. F. Black, Lancaster, Ill., and Dec. 29, to L. D. Phillipps, of Chicago. All were for improvements in, or aids to, hand binding with straw. It is a singular coincidence that during this same year the Marsh Bros. were inventing their harvester and seeking the same end—rapid straw-binding—but in another way altogether, their plan being to deliver the grain by the machine in the best possible condition and position to the attendant binders riding, leaving them to do the mere tying by hand, free from and undisturbed by the traps and aids proposed by others.

Allen Sherwood, Auburn, N. Y., Jan. 26, 1858, took out a patent, and Sept. 14 another, covering devices in his wire binder. The first patent claims binding the grain by means of a wire, placed on a spool and carried partially around the grain by the arm, in connection with twisting and cutting devices; and the second claims—in combination with fingers for throwing the gathered gavel up into the concave—the arm for carrying the binding wire up and over the sheaf and placing the wire in the slot of the twisting wheel; also the combination of the sliding knife with the twisting wheel for cutting off the wire, the twisting wheel with the wire carriers; and finally, the "forming a knot or enlargement on the end of the wire behind where it is cut off by the cutter, by twisting the portion of it," for the purpose of preventing the end from being drawn out of the slot in the twister. Aug. 30, 1859, he took out another patent covering improvements in his machine. Sherwood's binder was very ingenious and did good work. It was intended for attachment to reapers of the time, hence was not fully automatic, but required an attendant to work it. He spent several years in developing and in trying to introduce it, and a considerable number were built and used, giving promise of ultimate success, but the prejudice of farmers against wire and its high price proved too much for him. He fought manfully, working his binders about the country and at fairs, and he only failed because the conditions were too unfavorable.

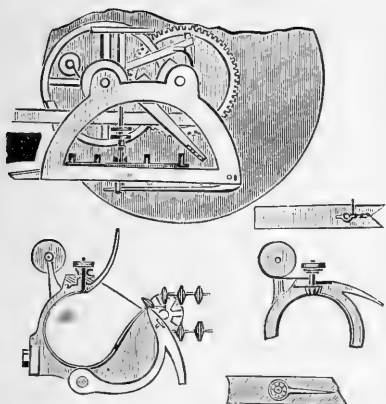
March 2, 1858, W. L. Childs, of New York, patented an ingenious twine-binder. The cord was taken from a spool located in the grain-wheel divider. It was passed under the platform and around in front of the receptacle into the nippers, above, in the arm; a self-rake swept the grain against the cord, which was forced back, receiving and encompassing the gavel; then the arm came down, the twine was cut off, and the ends were twisted and tucked under automatically. He also had a bundle carrier. March 23, a patent was issued to A. F. French, of Vermont, covering devices for aiding attendant to bind with straw bands, twisted by hand; May 11, to G. Notman, of Ohio, for a mechanism by which the binding was done with cords cut to lengths and placed by an attendant; July 6, to John P. Manny, of Rockford, Ill., on a machine something like the last, for binding with a prepared cord band, cut to proper length, having a knot

tied in one end and a little cast hook on the other, placed in position by an attendant, but automatically passed around the compressed gavel—hook and knot engaging as bundle expanded when loosened from the compressor, the binding mechanism operating in combination “with a rake that automatically throws itself out of gear,” etc.

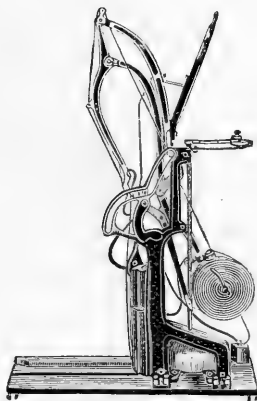
August 17, C. W. and W. W. Marsh patented their hand-binding harvester, which, though not belonging specifically to this class, became finally the foundation upon which practical binders up to this time have been built.

To J. Mitchell, Sept. 7, was granted a patent for an automatic straw-binder. “This invention consists in the use of clamps or band-carriers, a band-twisting device, tucking rod, and discharging device applied to the reaper, arranged relatively with each other and operated, whereby the grain is bound into sheaves and discharged upon the ground, the whole working automatically as the machine moves along.” It was not practical. The next patent, Nov. 16, was to Wm. Gray, of Ohio, covering ingenious contrivances for binding automatically with straw. The idea was suggested to him by the peculiar automatic self-rake of Jearum Atkins, mentioned in review of reapers. “Spring talons forked at ends and mounted on a turning post like Atkins’ self-rake, are brought down to the gavel by cam slot in post; they descend so that one talon strikes the heads and the other the butts; their spring ends being forced into the grain pick up a wisp for a hand; they then turn at right angles to the gavel, placing the wisp or band across it; descending further and coming together with band carried around the gavel, the ends of the bands are twisted by rotating pliers and tucked under; then the talons raise, lifting the bundle and dropping it upon the ground, and go back to place to repeat,” etc. One feature which is deserving of particular notice is described in first claim: “The arrangement of gravitating platform *F* 19, and the series of levers, *G*, *H*, *I*, *J*, with their accessories, in the described connection with a drive-wheel, for the automatic starting of the binding mechanism by the weight of the sheaf or gavel,” that is, the weight of the sheaf threw the binder in gear.

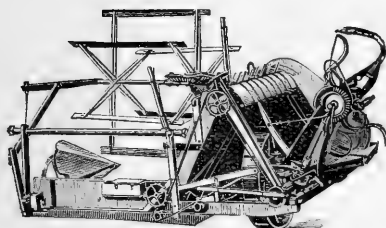
March 8, 1859, to A. Ralston, of Pennsylvania, a patent was issued on device for assisting attendant to bind with straw. It had a “shocking carriage” attached, in which a shock was formed and dropped upon the ground through its bottom. To J. D. Osborn, of Michigan, June 14, a patent was issued for a twine-binder, of which the claim is as follows: “A binding knot composed of three loops passed through each other, when said passing of the loops through each other is affected by machinery driven or moved from any of the moving parts of a harvesting machine, and whether accomplished by the means herein stated or by their substantial equivalents.” The cord or twine was taken from a reel. To F. Meyer, of Illinois, Aug. 2, a patent was issued for a very ingenious and complicated series of devices by which a straw rope band was twisted from the butt of the gavel and wound around the latter while being turned or rotated for the purpose. To C. H. McAller, of Wisconsin, Aug. 16, a patent was issued for devices to aid attendant in binding with straw by hand, and Oct. 11, to J. McAller for improvements on the same. To C. H. Durkee, of Wisconsin, Nov. 22, a patent



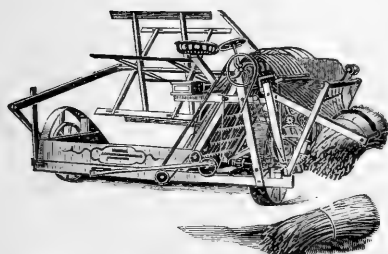
M'PHITRIDGE PATENT, 1856, FIRST WIRE BINDER.



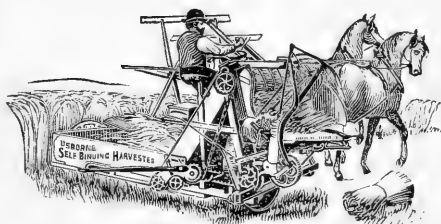
BURSON'S WIRE BINDER, 1861, ATTACHED TO A REAPER.



LOCKE'S WIRE BINDER, 1873.



JOHN H. GORDON'S "PACKER" BINDER, 1873.



JAS. F. GORDON'S "CRANE" BINDER, 1875.

was issued for mechanism arranged to assist attendant in binding with straw bands, cut and prepared.

In 1860, May 22, a patent was issued to D. W. Ayers, of Illinois, for a wire-binder, having a rotating arm, twisting device, cutter and holder, "all the parts working automatically by the turning of a shaft, and a gavel bound at each revolution of the shaft." To H. Kaller, of Illinois, June 5, a patent was issued for a wire-binder with a vibrating curved arm, and means for cutting and twisting the wire; and to A. B. Smith, of Pennsylvania, June 19, for cord-binder, the chief feature being its compressing arms, working independently of the cord arm, etc. June 26, W. W. Burson, of Illinois, obtained his first patent. This was for a twine-binder, to be used upon any reaper and to be operated by an attendant. It tied a knot in the cord by means of hooks working together. July 10 a patent was granted to J. Courser, of Illinois, for an automatic knot-tying device for taking twine from a reel; on the 17th of the same month, to J. S. Hickey, of Illinois, for a binder to be operated by hand, and to Chas. Marston, of Wisconsin, Aug. 14, for a very cumbersome and complicated machine for binding and shocking, and devices to aid attendants riding to bind with straw braid. It will be noted that all but two of the binder patents of 1860 were issued to citizens of Illinois, and one of these hardly belongs to this class.

In 1861, Feb. 12, a patent was issued to S. Reynolds, of Rhode Island, for a wire-binder, with arm, twister and cutter, operating automatically; to L. P. Harris, of Ohio, Feb. 26, for another wire-binder, which discovers nothing new. W. W. Burson, then of Yates, but now of Rockford, Ill., took out a patent on the same date, Feb. 26, 1861. This was for his wire-binder; and it was the foundation of a machine that made more stir, and came nearer to practical success and public approval than any other of the various binders belonging to the first era. It was constructed as an attachment to the ordinary reaper. As the gavels were raked into the binder, an attendant sitting beside it turned a crank giving the necessary movements for binding the bundles. Other patents for improvements were issued to him as follows: To H. M. and W. W. Burson, March 3, 1863; to W. W. Burson, Aug. 11, 1863; also Oct. 4, 1864, and July 25, 1865, the two latter patents covering devices for adapting his binder to the use of twine. Burson's first binder, built in 1859, patented June 26, 1860, and mentioned before, bound with twine, but as that material was not easily obtained he turned his attention to wire. He had two wire-binders at work in the harvest of 1860. The next year some twenty-five of them were built at Muscatine, Iowa, for attachment to the John H. Manny reaper, and were worked in the harvest from Vandalia, Ill., northward as far as Red Wing, Minn., several being sold to farmers. In 1862 about fifty more were made. One of them was at the great reaper trial at Dixon, Ill., that year. It made a decided sensation, and notices of its work appeared in many newspapers of the time. As said by the *Chicago Tribune*: "The great feature of the day, which never failed to draw the crowd, was the grain binder of W. W. Burson;" and by the *Farmers' Advocate*: "Burson truly had an ovation that must have been gratifying to him." It was used on a John H. Manny six-foot-cut reaper, made by Talcott, Emerson & Co., of Rockford, Ill. Burson ar-

ranged with this firm to build for him 1,100 of his binders for 1863. These were good machines and worked well, but the prejudice against wire and its cost at war prices operated against them. They were mostly sold, however, and used for many years thereafter; but a profitable market could not be established for them, so their manufacture was discontinued. Yielding to the objections against wire, he turned again to twine-inventing and substituted a knotter in place of his wire twister, and he had this in successful operation in 1865. During the winter following Mr. Emerson went to every twine factory in the United States, and to agents of foreign manufacturers of twine, to find or to get made what should be sufficiently cheap and also strong enough for practical use as material for binding. Nothing then could be produced, on account of war prices and crude machinery, that would answer the purpose. Still determined to succeed, Talcott, Emerson & Co. imported machinery and began manufacturing twine, but their factory burned up soon after, and they discontinued further efforts. At this time, too, the Marsh harvester was rapidly gaining favor, and on the score of economy was a successful competitor against any sort of binder, no matter what kind of material might then be used on the latter. Mr. Burson says that he got on a Marsh harvester cutting rye in 1866, and bound two rounds alone, at first trial. He decided there that a binder had to be made fully automatic, and that material for binding must be cheaper to enable a self-binder to compete with the harvester.

In 1861, Oct. 29, to C. Alvord, of Wisconsin, a patent was issued for reciprocating gavel carriers, presses, etc.; to C. Powers and P. Lancaster, of Michigan, Oct. 29, for a twine-binding attachment which had considerable merit, its chief feature being a rotating head in connection with a swinging arm. The ends of the cord were held by a tight twist.

In 1862, April 15, to A. S. Harding, of New York, a patent was issued for a machine to rake and bind grain with straw taken automatically from a box, put around gavel and ends twisted, clamps and other devices helping in the operation; to J. H. and A. E. Rodstone, of Indiana, Aug. 19, for rake and straw-binding devices, and to J. M. Grosh, of Pennsylvania, Oct. 28, for something of the same general character.

In 1863, Jan. 13, to H. Palmer, of New York, a patent was granted for an automatic twine-binder. The grain was drawn from a slotted platform by a reciprocating rake, when it was caught by a cradle and delivered to hooks, clamped and bound by a series of operations and devices. To R. D. Brown, of Indiana, April 7, a patent was issued for a complicated machine which, in addition to binding the sheaves, deposited them in bunches on the ground, and had a device for counting the number thus dropped; to W. H. Harrah and H. P. Jones, of Iowa, June 30, for a wire-binding attachment operated by an attendant; to J. Judevine and Z. Shaw, of Wisconsin, July 14, for a similar wire-binding attachment; to A. B. Smith, of Pennsylvania, July 28, for improvements on his twine-binder, first patented June 19, 1860; to A. Underwood, of Wisconsin, Aug. 11, for a very ingenious automatic twine-binding attachment, which was constructed on its own platform, taking the place of the reaper platform when attached, and forming thus a complete machine (the cord was twisted and then tied, and an auto-

matic fork discharged the bundles); to W. D. Harrah, of Iowa, Dec. 22, for a novel binding mechanism, the gavel of grain being pressed endwise into a compressing tube on which were prepared endless bands, one of which was slipped over the sheaf as it passed out of the tube, the expansion of the bundle tightening the band around it.

In 1864, Jan. 26, S. T. Holly took out two patents on binder. Jacob Behel, then of Earlville, now of Rockford, Ill., Feb. 16, obtained a patent for one of the most important inventions ever made on binders, viz.: the knotting bill and turning cord holder. The bill, which was substantially like all in use now, seized the portions of the cord which were to form the knot, and looping the same, moved back past the knife, which severed the cord at the proper point, leaving the end of the cord from the reel (or ball) firmly held by the turning cord wheel. Mr. Behel, in connection with W. Hedges, took out another patent Sept. 6, which has, among various claims, one for an adjustable cord guide located between reel (or ball) and binding arm; and his patent of Sept. 19, 1865, claims a friction apparatus, swinging frame and cord guides, for the cord as taken from the spool (or ball), also the combination of tying bill and moving knife. Mr. Behel was a meritorious inventor, but unfortunately he was too early; for when the time came for all the world to use his inventions his patents had nearly all expired. To S. J. Wallace, of Illinois, April 12, 1864, a patent for a wire-binder was issued having several ingenious and important features—a rack for giving motion to twister, etc.—but it is too long and complicated to describe. T. T. Curtis, of Michigan, May 3, patented a machine that combined a self rake, binder and shocker. During the balance of the year no binder patents were issued except those to Burson and Behel, already mentioned.

This brings us down to the year 1865 on all the binder patents issued previously, and here we may stop taking them in course, for lack of time and room, and because also here ended, with Burson's final effort, all hope on the part of practical men, of establishing a marketable self-binder with conditions as they were, i.e., with material for binding so dear; with the difficulties in the way of making any binder work in connection with a reaper or on the "low-down" principle; and with the Marsh harvester on the market then as a successful competitor on the score of economy against any binder, no matter how thoroughly practical in operation it might have been. It is somewhat remarkable, too, that the Marsh harvester, which at that time repulsed binders, should be the very machine which a few years after invited them on.

"The first clear idea of an automatic binder as an attachment to our harvester," says Mr. Marsh, "I got in July, 1870, in this manner: I was then operating one of the machines, which we had sold to the government, at Ungarisch, Altenburg, Hungary, upon the farms connected with the Agricultural College. Prince or Archduke Nicholas, of Würtemberg, was stopping there at the time and became very much interested in the trials of machines then in progress. One afternoon, after he had followed the harvester around several times, watching the operation of machines and binders, as he had frequently done before, he asked me to have them stop at the end furthest from the crowd (which, by the way, was not allowed to follow).

He then said that such men as they had in Europe would never bind by hand successfully, but that an automatic binder should be put in their place. Evidently he had been studying the subject, for he explained quite in detail his plan—the location and movement of the binder, which was to use wire; in short, he gave me the general outline, which several years after I saw in Gordon's "crane" binder; and he asked me to remain over and help him, with such good mechanics as we could get at the institute, to produce a binder for the following season. I had no idea, then, of the importance of his suggestion, and gave it scarcely a thought, except to wonder at his inventive disposition and I never heard further of him."

There were several binder patents granted during the year 1865, but none of them represented successful inventors or machines, except two issued Dec. 19, to S. D. Locke, of Janesville, Wis., one covering a compressing device, the other his rotating hook twister. Locke says he began in 1861 to build a binder which, after nearly completing, he abandoned, to commence on one of another style or plan. From this commencement to 1869 he was engaged in efforts to adapt binders to reapers, working on different plans and taking out various patents. In the spring of 1869 he arranged with Walter A. Wood & Co., of Hoosick Falls, N. Y., and went there. He tried first to fit his binder to the Wood self-raker; but gave that up and then put one on a heading machine, operating it with fair success in 1870. The company built several for these headers the next year. In 1872 he attached one, as he says, to "a harvester of the modern or Marsh type." They built five on this plan in 1873, of which four were used for that harvest. Next year a few more were built and the next three hundred, and after that they were put upon the market in large numbers by the Wood company, up to 1880, inclusive.

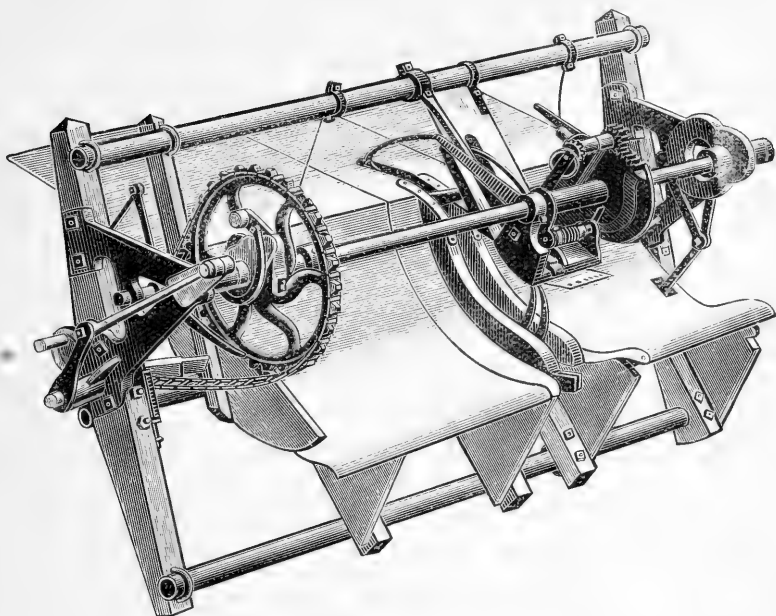
Mr. Locke took out patents too numerous to mention. He claims to be the first man to build an automatic binder as a distinct and separate machine for attachment to a harvester, and Walter A. Wood & Co. were the first to build and put regularly upon the market successful automatic binding machines. While it is probably true that Mr. Locke was the first inventor of binders on record who made a final success, and that success began with the adaptation of his binder to the Marsh harvester in 1872, yet to S. D. Carpenter, of Carthage, Mo., then of Madison, Wis., probably belongs the credit of the first attempt of the kind. Carpenter seems to have been the first to discover this necessity to binders: the elevation and then downward delivery of the flowing stream. He began his binder work back in 1861 or 1862, in the usual way for attachment to reapers; and although there is some dispute or discrepancy as to dates, he certainly had a binder on a Marsh harvester as early as 1867. His machine created considerable of a sensation, was successfully exhibited and a number experimentally built, but they did not get it upon the market.

In the long list of meritorious inventors the name of James F. Gordon, of Rochester, N. Y., and of his brother, John H. Gordon, should stand out prominently on account of their valuable work and their persistent efforts. James F. began inventing in this line as early as 1862 and had a full-sized machine in 1864. He continued his experiments under adverse conditions

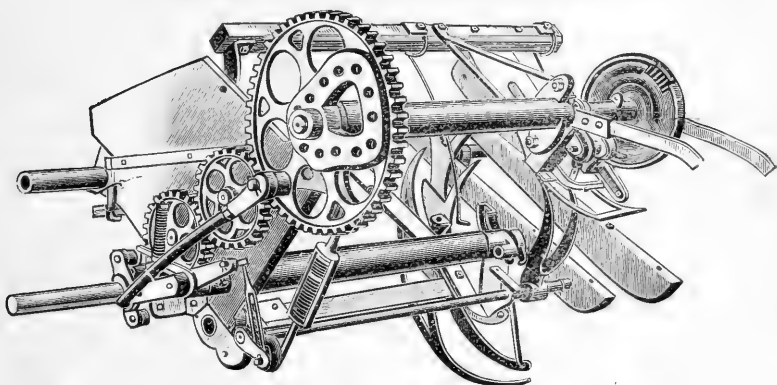
—lack of means, and other disadvantages—getting a second machine built in Kalamazoo, Mich., in 1867, and another in Rochester, N. Y., in 1868, which was successfully operated near that city and elsewhere during harvest. May 12, of that year, his first patent was issued. Meantime he had been compelled to dispose of interests in his inventions to provide funds for this development. He built several for the next season which were used in the field, and exhibited at fairs—but success was not assured until 1871, when he procured a Marsh harvester and attached his binder thereto, with which new combination he did good work that harvest. He continued on this last plan, assisted by his brother, John H., through 1872 and 1873, building, perfecting and exhibiting their binders as attached to harvesters. Aug. 27, 1872, he obtained a patent on the improved machine, and June 16, 1874, on another. On account of peculiar construction one of these early binders was designated the “gaveller” and the other as the “reciprocator.”

John H. Gordon, then living at Kalamazoo, Mich., built his first “packer” binder during the fall of 1873, and prior to the next harvest three were completed for the market. He bought three Marsh harvesters upon which to place them. One of the machines thus combined he sold to Ed. McElroy, living near Kalamazoo, for \$300 cash. This is believed to be the first cash sale of an automatic binder on record. It did excellent work and bound about one hundred acres. Gammon, Deering & Stewart became interested in Gordon binders in 1873 and in 1874 began putting them on the market. J. F. Gordon produced soon after what was known as his “crane” binder, which was built largely by Gammon, Deering & Stewart. D. M. Osborne & Co. also built this, taking license from both the brothers on their machines; and D. M. Osborne afterward bought an interest in their patents. J. H. Gordon next invented his “crank and guide-arm,” or the Buckeye wire-binder—so called after this concern took license and began building. This was in 1878. The next year Walter A. Wood & Co. took a license on this last machine, as improved, and made a couple of hundred before they changed to twine. Having thus brought their several wire-binders to a high state of perfection (and it is a striking peculiarity that all worked well from the start) with several of the largest manufacturers as their licensees, building thousands annually, the world seemed fairly in their grasp, when suddenly the twine binders surged to the front and captured the whole trade.

Along in the early part of the “seventies” several ingenious binding machines were patented by various inventors. W. H. Payne began them and continued thereafter with varying success, until the Appleby swept him and others out of the market. It is said that he was the first to use a bundle carrier with a binder. There were Spaulding, with his measuring or trip device; Barta, Chapman and Fowler, with his ingenious mechanism for stitching a band around and into a bundle. Keller and Storle did good work, and so did Travis and J. F. Steward later. John H. Whitney patented his binder, low-down, in 1870 and 1872, and was making rapid strides toward success; but his fire was too intense and he soon burned out, dying in 1872.



THE APPLEBY EXPERIMENTAL BINDER, AS MADE AT BELOIT.



THE APPLEBY "STANDARD" BINDER, AS FIRST PUT ON THE MARKET.



BEHEL'S TYING BILL—FORMING THE KNOT.

Geo. Draper, of Mazomanie, Wis., an Englishman by birth, but forty years in this country, while an invalid, invented and had built in 1870 and 1871, a very ingenious binder, applying it to the Kirby reaper. It is said that it was a very creditable effort, and that among other practical devices it had an automatic trip lever for starting the binding mechanism under pressure from the grain. Ill health and lack of means prevented the full development of his ideas.

So much misfortune had all along befallen these various efforts to attach binders to reapers, that the attention of inventors about that time became directed to another method of gathering and binding the grain, resulting in the peculiar machine called the "gleaner," which is a binder attached to a raking device for gathering gavels, deposited on the ground, from a reaper, and binding them. A patent was granted to M. T. Ridout, Nov. 14, 1871, for the first gleaner. Other patents were issued on this style of machine to J. A. Scott in 1873, Leuz and Wittker in 1874, and afterwards to R. Eickmeyer, M. G. Hubbard, Samuel Johnson, W. N. Whitely and others. Many of them were built and used successfully, especially in the eastern and middle states.

Had Marquis L. Gorham, of Rockford, Ill., lived to complete his work, it is altogether probable that his name would have been among the first of the successful inventors of twine-binders. He began on his binder in 1873 and had it done for the harvest of 1874. He attached it to an "altered over Marsh harvester." This machine did good work in the harvest of 1874, cutting and binding many acres. Mr. Gorham obtained patents on it Feb. 9, and March 16, 1875. He continued his experiments, making improvements and applying for patents thereon, until sickness intervened, and finally death in the fall of 1876 brought to rest his overtaxed body and brain. Some efforts were made to finish his work, but the master spirit was no longer present to guide it to successful completion, and it was not pushed forward with sufficient promptitude to obtain a place before the Appleby had captured the market on this style of machine. Mr. Gorham was a brilliant inventor, quick in perception, rapid in execution, and practical always. He added much to the perfection of farm implements. His seeders, cultivators, etc., are well known all over the western country.

The St. Paul Harvester Works, of St. Paul, Minn., did a large amount of pioneer work. They were among the first to build, exhibit and put upon the market modern cord-binders, under the Ellward and Levalley patents. The binder operated fairly well, and they were gaining ground with it, until the Appleby and Holmes stepped in before and demolished them.

Chas. B. Withington, of Janesville, Wis., patented Feb. 20, 1872, and May 19, 1874, one of the best and most successful wire-binder ever put in the field, as attached to the Marsh harvester manufactured by C. H. and L. J. McCormick & Co. This binder differed essentially from the Gordon and other wire-binders, in its chain movement, in carrying two spools of wire from which the bands were formed, and in other operating devices. In 1874, or early in 1875, Withington sold a half interest in his patents to the McCormicks and made general arrangements with them for the development and manufacture of his machines. They built three or four experi-

mental binders for 1875; thirty or forty in 1876, and in 1877 they were put regularly upon the market, where they held a foremost place until 1881, when the McCormicks began building the Appleby.

No name is so well known among persons interested in harvesting machines as that of John F. Appleby, and no machine ever swept over the world with such overwhelming rapidity—once it got started—as the twine-binder designated the “Appleby.” This success was not due to the newness of the devices applied, nor to the surpassing character of Mr. Appleby’s genius, although he has been a persistent and clear-headed inventor; but it would seem that the ingenuity of a number of inventors, running in the same direction, had become massed or dammed before certain common obstructions, beyond which they could not flow; and it was reserved for him to combine in his binder—built upon the Marsh harvester—the most practical of these principles, directing the best efforts into one channel; and by devices of his own to remove the obstructions, thus opening the way for the flood that followed.

In the fall of 1881 W. N. Whitely, then the head of the Champion interest at Springfield, Ohio, who had been experimenting largely with low-down and other binders since 1875, bought the interest of Appleby and his assignees in his many patents. Others had obtained licenses or shop rights, or arranged with Whitely therefor. So from that time and onward the twenty odd manufacturers of the United States have been running substantially in one groove, building the Appleby type of binders upon the Marsh type of harvesters, each applying special or distinctive devices in accordance with his bent, the Holmes binder only, built by the Walter A. Wood company, differing from the others in some of its principles. Mr. Holmes, the inventor, began experimenting in this direction as long ago as 1868, it is said. He was poor, and struggled along as best he could, until 1879 when the Wood company gave him assistance. His patent was granted Dec. 3, 1878.

CHAPTER IX.

Mowers.

MAKING hay—cutting and drying grass for fodder—was a familiar duty among ancient stock raisers. The process is frequently alluded to in the Bible, but the uses of hay are now nearly or quite forgotten in Palestine, straw and chaff having long ago supplied its place for fodder. From primitive times down to the present there has been no material change in the process of manual mowing. The scythe of the pre-historic Lacustrine inhabitant of Switzerland was curved, and was attached to a handle, forming an implement substantially the same as we now use, and that likewise, when swung into the grass or grain, described the segment of a circle in cutting; and so does the sickle. It was this natural primitive movement that the first constructors of both reapers and mowers tried to imitate or reproduce in their machines, and early American inventors of mowers persistently endeavored to make practically operative this original principle. Indeed, it was many years before the rotary or scythe-curve theory of cutting was abandoned.

The idea of mowing grass by horse power was conceived in America, and the first patent ostensibly covering a machine of that character was granted to Peter Gaillard, of Lancaster, Pa., Dec. 4, 1812; so, according to the record, he was the first inventor in this line. Previous to the date of this patent several crude reaping machines had been produced in England, but none of them had passed the experimental stage or been put up in practical form, and all were intended, as their construction and descriptions indicate, for cutting grain and not grass. The credit for the conception, therefore, of mowing grass with a machine propelled by other than man power belongs to an American inventor, although, because reapers and mowers are usually classified together, writers on this subject speak of these old English reapers as mowing and reaping machines.

Jeremiah Bailey, of Chester county, Pa., Feb. 13, 1822, patented a mower or grass-cutting machine which made considerable stir at the time, in England as well as in this country. The *Mechanic's Magazine* (British), 1823, describes it as follows: "The mowing machine of which the above cut is a representation was invented by Jeremiah Bailey, of Chester county, United States, who has obtained a patent for the same. It has been extensively used and approved of during the last season in the neighborhood of the patentee, and promises to be of great public utility. It is understood that it will mow ten acres per day. The following description will explain its operation and show the skill and ingenuity of the inventor:

"This machine is supported by two wheels on different axles. The left wheel is fixed to its axle, so that they revolve together. The right revolves

on its axle like a common cart wheel, and is placed about a foot further back than the other. The left works within the frame, and has a circle of cogs screwed on the outside of the felloes, but of a less diameter, to keep them from the ground. These cogs work into a vertical cog wheel in front that turns an iron shaft extending horizontally toward the center of the machine; upon the inner end of this shaft is fixed a vertical face wheel, whose cogs turn a trundle-head on a vertical shaft. To the bottom of this shaft, near the ground, is fixed a circular horizontal framework, on the circumference of which is screwed the scythes in six parts, laid horizontally, with the edges turned outward, so as to form a complete circle. To keep the scythes at a proper distance from the ground the bottom of the shaft is supported on a piece of wood of the machine, secured by a tie from the tail, somewhat resembling a sled runner, in which it works in the manner of a gudgeon; with the inequalities of the ground the scythe frame shaft and trundle-head rise and fall. The edge of the scythe, in its revolution, passes under a whetstone fixed on an axis, and revolving with the scythe. To create friction this axis is more or less inclined to the line of the direction of the revolution, according to the friction required. This stone, by means of a sliding rod by which it is attached to the machine, rises and falls with the scythes.

* * * The horse is put into shafts and walks in front of the left side of the machine, and always on the mowed ground after the first swath is cut.

* * * The grass as it is cut is first thrown by the progressive motion against a rise in the scythe frame toward the center, and by the same motion is afterward thrown off in a regular row, following the center of the machine."

The next patent was granted July 3, 1824, to John A. Wadsworth, Portsmouth, R. I., for a horse scythe. May 18, 1825, E. Cope and J. Hoopes, Jr., of Chester County, Pa., received a patent on a mowing machine somewhat similar in principle to that of Jeremiah Bailey, described, but of better form and simpler construction. A letter written in 1854, by N. Cope, son of E. Cope, contained the following regarding this mower: "This was a very efficient machine, but was chiefly used for mowing grass, and it would cut an acre in thirty minutes by the watch, better than it possibly could be done by hand. I assisted to build some twenty-five or thirty of them before I came west, and I much question whether, for the purpose of grass-cutting, a better or more simple machine has, or ever will be, constructed."

As reapers and mowers belong to the same original general class, "harvesters," and have, as was particularly the case at first, so many features in common, it is somewhat difficult at times to draw the line between them. In many of the older patents they are described as machines for reaping and mowing, having been designed for both purposes, and in some specifications they are described first as one and then as the other without distinction of purpose; so one cannot always clearly understand to which division of the general class the inventor intended his machine, or to which it really belonged. Taking Hussey's invention as an instance: Contemporary and later writers usually speak of it as a mowing machine, while in fact it was essentially a reaper, and made its record as such, although it was designed to both reap and mow, and introduced features without which mowers could not have been made sufficiently practical for the general trade. In

the course of later development the lines become less mixed and more divergent, until now the distinction between mowers and reapers or harvesting machines is plainly marked. Mowers, with reference to the manner in which the power is attached, are known as center-draft and side draft; with reference to their bearing wheels, by which power is communicated to the cutting devices, they are one-wheeled and two-wheeled; and as to adjustment of the cutting devices are known as rigid-bar and hinged-bar. These are general distinctions of which there are respectively many variations.

There is no difficulty in distinguishing the invention of Erastus Ingersoll, Farmington, Mich., patented May 7, 1830. It was unquestionably intended for cutting grass, with what success one may judge from the description: "Runners bearing some resemblance to those of a sleigh are framed together. A roller extending across from one of these to the other at the back part rests upon the ground, and revolves when the machine is drawn forward. Two pieces serving as shafts extend forward, being secured by proper framing. The moving or cutting part is a horizontal wheel about eight feet in diameter, running near to the ground, its lower gudgeon fitted in a piece framed across the runners, and its upper is one of the shaft pieces. A band from the roller extends to a wheel on the axis of this cutting wheel to give it motion. The cutters are knives fitted on to the periphery of the wheel so as to form a complete circle."

Although the next patent, to William Manning, Plainfield, N. J., May 3, 1831, covered what was designated a reaping machine, its cutting device marked an important step in the development of mowers. Quoting from the description: "From the axletree extend two arms. * * * The two arms are united together by a cross-bar at their extreme ends, which cross-bar when the machine is in action rests and slides forward on the ground. Teeth of six or eight inches in length, more or less, are set like rake teeth, standing forward on the cross-bar. These are made slender, and are for the purpose of holding the grass or grain to be cut * * * A flat bar of iron lies along upon the cross-bar, and the cutters are to be attached to this upper bar. The cutters are spear-shaped, and are sharpened on each of their edges. They may vary in their length and width, but ordinarily they may be about six inches long, and three or four wide at their bases. The grass or grain, which is held up by the teeth, passes between these knives or cutters." April 26, 1833, Richard Heath, West Newbury, Mass., obtained a patent for a mower similar in principle to the Bailey, and so, June 29, 1833, did Thos. A. Anderson, of McMinn county, Tenn. Both these machines drove revolving scythes placed near the ground, and neither contained anything specially new and valuable in the art.

When the invention of Obed Hussey, Cincinnati, O., patented Dec. 31, 1833, was added to the others that have been mentioned, the foundation of reapers and mowers had become substantially laid, and thenceforward the erection of structures thereon and the perfection of their details became the chief work of inventors in this line. The main feature of his invention, the cutting device, is thus set forth by Mr. Hussey. "The cutting blades are of lancet-point shape, and sharp on both sides; these are fixed side by side on an iron rod, in the position of sawteeth, and receive a vibrating motion

from a crank to which the iron rod is attached; these blades project forward from the front edge of the platform towards the grain, and play through a corresponding row of permanent iron guards or fingers, which also project forward from the front of the platform. As the machine progresses forward the grain or grass comes in between the stationary guards or fingers and is cut off by the vibrating blades. * * * The great point in this invention is the double finger, in combination with the vibrating blades, each finger being formed of an upper and lower half, with sufficient space between for the passage of the blades through them. The straw or grass to be cut is supported both above and below the edges of the blades, and is cut off as the blades pass through the fingers by the revolution of the crank." In this first machine the upper part of the guard came back to the sickle beam, and the result was that grass or stubble drew in and more or less choked the sickle. Some years after, by cutting off the rear end of the upper portion of the guard and leaving it open, so that stuff might work back and out—thus forming what has been called the lip of the guard—Mr. Hussey effectually remedied the difficulty, and a practical cutting device for harvesting machines, substantially as used to this day, was produced. Manning, in 1831, showed the guard-teeth or fingers attached to the beam over which a sickle or cutter, similar to Hussey's, was made to vibrate, but these guards or fingers were single, that is, no lip or returning piece over the sickle was provided, hence it was not and could not be a practical cutting device because it lacked the step toward completion that Mr. Hussey took. However, in the development of this feature, Manning—as an inventor simply—is entitled to as much credit as Hussey, for he stood midway between Ogle and Hussey, and made fully as long a step as did the latter.

December 23, 1834, Enoch Ambler, Root, N. Y., obtained a patent for a machine to cut grain by horse power. There seems to be much difference of opinion as to the merits of Ambler's invention. Contemporary writers refer to it rather contemptuously, but an examination of the cut of his old finger-bar will show that for one of the earliest efforts it was a long step in the direction of successful grain cutting by horse power.

The next patent in this line was granted to Abraham Rundell, Verona, N. Y., April 22, 1835, and covered a new idea in cutting. The device consisted of two sickles, or cutters, with corresponding points, to be operated in contrary directions, thus making a double shear cut with each pair of points, the whole operating like a series of double-acting scissors. This was the first of a number of inventions and improvements upon the same principle made both in this country and in England; and the cutting device of one of the most successful mowers of its time, the Danford, was of this character.

The first patent of Wm. F. Ketchum, Buffalo, N. Y., was issued Nov. 18, 1844. There is nothing of special importance in this first patent of Mr. Ketchum's, but it is worthy of notice because he was the father of the mower trade; that is, he was the first man to put mowers successfully upon the market distinctively as such and not as combined with the reaper. The chief claim and the one relating to mowers in this patent was as follows: "What I claim as my invention is the combination of the driving-wheels

with the cutters, in the manner described, by forming internal gear on the wheels and inclosing all the driving gear inside of them by the construction and arrangement above set forth." Another patent was granted to Ketchum March 7, 1846. It had no bearing upon mowers, but his next, July 10, 1847, as it furnished a new feature of value to mowers and to reapers and mowers combined, became quite important, especially as afterwards re-issued. The claims in the re-issue are as follows:

"First. Placing the cutter-bar and cutters lower than the frame of the machine, and opposite the side of the plane of the wheel, in such a manner as to leave unobstructed space below the frame, and also between the wheel and the cutters with their supports, to allow the machine to pass freely and without clogging over the cut grass or grain, as set forth.

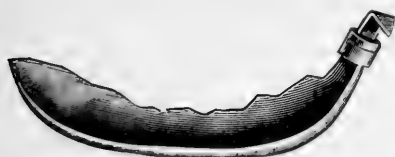
"Second. Placing the cutters lower than the frame and axle, and in or nearly in the same vertical plane with the axle on which the frame hangs and vibrates, and parallel or nearly so to said axle, so that the vibrations of the frame on uneven ground shall not materially elevate or depress the cutters, as herein set forth.

"Third. The endless chain of cutters in combination with the guard-teeth, operating substantially as described."

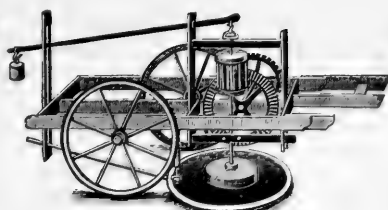
The main feature of this patent was the unobstructed space between driving-wheel and finger-bar and its supports. The endless band of cutters did not work satisfactorily, although when the machine came out it created a great flutter among reaper men, as its extreme simplicity and great possibilities, if it proved practical, were apparent to all.

The next name to be noticed in the order of mower development is that of Eliakim B. Forbush, who obtained a patent Nov. 17, 1849. His claim in this, his first patent, is on an open triangular tooth, or triangular hollow tooth for cutting grass and grain, "the object being to diminish friction in vibration and to afford a more perfect clearance." Following Mr. Forbush further we find that July 20, 1852, another patent was issued to him embracing four claims relating to guard fingers, etc., also to a pivoted raking arrangement. This patent was afterwards assigned to Cyrenus Wheeler, Jr., and re-issued in several divisions, mainly to cover points pertaining to reaping machines. The Forbush machines were made in Buffalo, N. Y., and were put out both as combined, and as mowers simply. The machine was quite similar to the Ketchum, and in consequence the firm manufacturing it—the Smith Brothers—were sued by Mr. Ketchum for infringement, and were forced to discontinue making it.

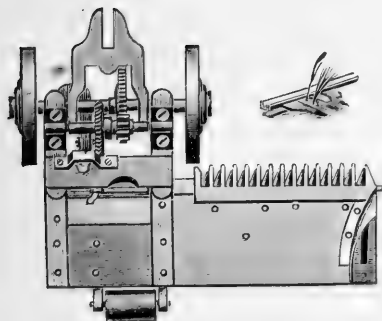
One of the men engaged in constructing the Forbush was William A. Kirby; and from witnessing the operation of that machine in the field he concluded to get up one that might avoid its defects. The first Kirby machine was completed in 1855; and the first patent was granted April 15, and the second Sept. 2, 1856. The first related to the method of connecting the guard-fingers to the finger-bar, and projecting rivet heads and spaces in connection with the cutters and fingers. The second patent contained the important feature of pivoting the main driving and supporting wheel to an arm which was in turn hinged to the frame of the machine concentric to the first gear shaft; which arrangement permitted the wheel to swing on its



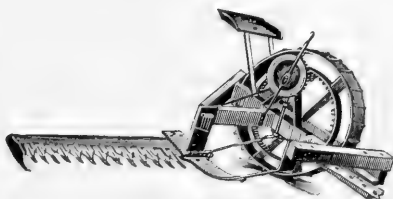
PREHISTORIC SCYTHE.



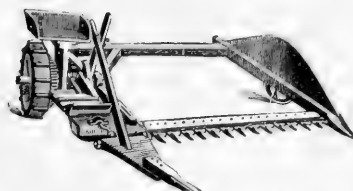
BAILEY'S MOWER, 1822.



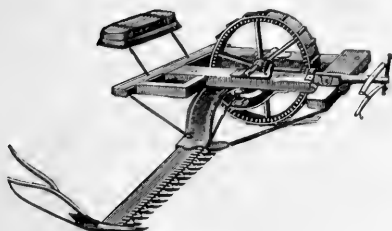
HUSSEY'S MACHINE, 1833.



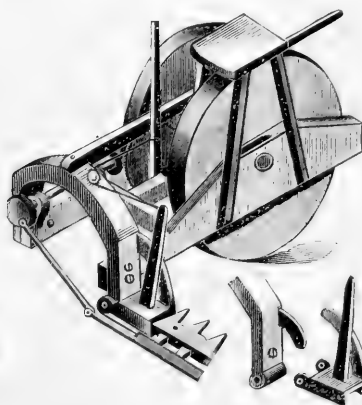
FORBUSH MOWER.



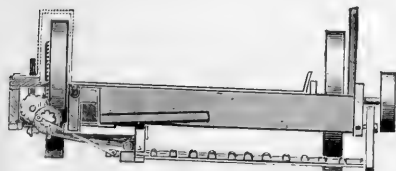
JOHN H. MANNY'S MACHINE AS A MOWER.



KETCHUM'S MOWER, AS BUILT.



CYRENUS WHEELER, JR., 1854.



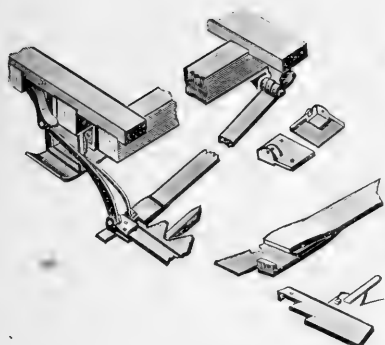
SYLLA & ADAMS, HINGED BAR, 1853.

hinged connection with the gear frame, independent of it and the frame and the cutting apparatus connected therewith to rise and fall independent of the up-and-down motions of the road wheel. A seat for the driver was pivoted to the frame of the machine and fulcrumed on the axle and its arm, so that the weight of the driver was added to the wheel to give it sufficient adhesion to drive the cutters, and at the same time relieve the cutting apparatus and frame from undue pressure on the ground when used in mowing. Mr. Kirby, from time to time, improved and perfected his machine, which, like the Ketchum and Forbush, was one-wheeled, with rigid-bar, although the latter had a certain adjustability as described. It became by far the most successful of the type. The three started at Buffalo, N. Y., one seeming to grow out of the other, and finally they were more or less merged or consolidated by D. M. Osborne & Co., at Auburn, N. Y., whose machines, combining all the best elements of these originals and other improvements, soon became famous, principally as reapers, but also as mowers.

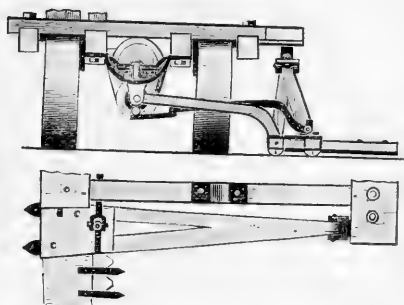
Going back to Sept. 17, 1850, we notice the patent granted to Ebenezer Danford, with claim as follows: "The application to a reaping and mowing machine of two sickles working together in opposite directions, * * * so as to throw the weight of the moving part upon opposite sides of the center of the crank or bit, for the purpose set forth." Mr. Danford's machine did not make much of a record as a reaper; but as a mower it was quite noted for its excellent cutting qualities, though the time and care required to keep the sickles in good working order proved a bar against its entrance into general favor. A considerable number of them were made, sold and satisfactorily used.

No one of these early machines made a better reputation in its time than the combined reaper and mower of John H. Manny; and thirty-five years ago in the northwest as a mower it was considered the best of its class. Manny's first patent was granted Sept. 23, 1851, and covered his triangular frame, which was one of the principal features of his machine as a reaper. Nov. 23, 1852, he obtained another patent covering the combination of a "track scraper" with drive wheels; and also the form and construction of guard fingers so as to cut well and avoid clogging. This and other patents were re-issued largely (as usually were important patents during those early years), but they related to details of construction rather than to new principles. Manny was a practical as well as a prolific inventor, and his machine had obtained a foremost position early in the race when he died.

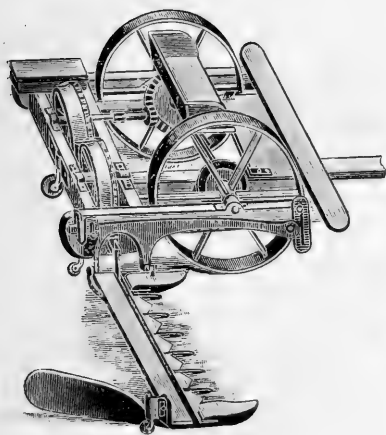
By 1855 one-wheeled rigid-bar mowing machines had become practical, either in connection with reapers or as mowers alone. Concerning some features it is impossible to determine definitely who presented them first; and others shade from one into another so finely that it is difficult to distinguish them. Often they comprised series of evolutions within the one grand evolution by which harvesting machines have been developed and perfected, and again the first use of a device is not clearly shown, as in the case of "track-clearers." For instance some of the earliest English machines show a separating and gathering away of the cut from uncut stalks. In Hussey's patent of 1833 there is a device, shaped somewhat like the mouldboard of a plow, at the grain end of the bar, that, with platform re-



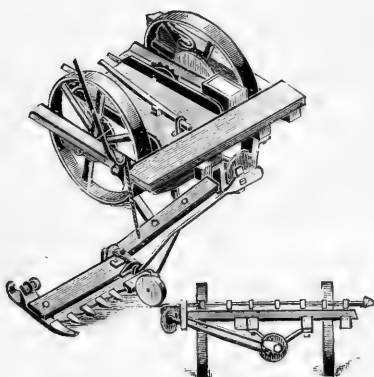
E. BALL, 1856.



E. BALL, 1857.



JOHN LONG, 1857.



LEWIS MILLER, 1858.

moved, would turn the swath away from the standing grain or grass. It is said that Joel Lupton put on what was avowedly a track-clearer in 1841. Several just mention them in their claims; Ketchum patented one in 1853; Whitely another in 1854; Wheeler in 1855, and thus they were evolved.

TWO-WHEELED MOWERS WITH HINGED BARS.

Apparently the first conception of flexibility or automatic adjustability to the ground surface in the cutting apparatus was shown in the mower of Jeremiah Bailey, 1822. Hussey's machine of 1833 had its draft attachment in front of two driving wheels; and the frame behind, which bore the laterally projecting finger bar, having been hinged to the main axle and supported in the rear by a little wheel, could to a certain extent accommodate itself and the cutting apparatus, in the forward movement, to the inequalities of the ground uncontrolled by the passage over of the driving wheels. This was the beginning of practical flexibility.

The next machine in order that showed the features which we are tracing was never patented, but became somewhat famous for reference in after years. The following account of it is extracted from Knight's "Mechanical Dictionary:" "Hazard Knowles, the machinist of the Washington patent office, invented in 1837 a reaping machine having a scalloped reciprocating cutter; the cutting apparatus jointed to a double arm, the opposite end of which was in turn jointed to the main frame, coincident with the axis of the crank-shaft; both supporting wheels were drivers for the cutters. It was a front-cut machine, and had a lever to raise the cutter-bar to clear stumps and other obstructions. A machine was constructed in 1838, and in 1839 was purchased by Joel Lupton, who rode upon the machine along the turnpike to his home, near Winchester, Va. The machine was used occasionally during a few of the following years, but was soon laid aside, owing to a fear of the neighbors that it would disturb the relations of labor. It was afterwards purchased by one of the large firms of reaping machine makers who became involved in the tedious and expensive litigation which ensued when the reaper became an important article of manufacture and trade. This machine is principally curious in its anticipation of so many of the important features of the more useful machines. Like Bell's machine in its history, though far superior to the Scotch machine in mechanical structure and adaptability, it was a conception embodied in a single machine, and became an abandoned experiment, to be brought forward when the inventions and contests of others gave it importance. It was a machine of great possibilities, but the inventor failed to assert his rights. His position in the patent office prevented his becoming a patentee, and he preferred to retain his salary to embarking in the business of making machines of so novel a character. About 1863 the machine was brought forward in a patent suit. It may be presumed that it formed but another instance of the rule, that a single machine made and practically hidden away, shall not be allowed to defeat a patent, when a subsequent inventor has showed due diligence. It also indicates that the patent is a *quid pro quo*, an exclusive right in return for an invention adequately described on record." In his famous contest with Wheeler et al.—the suit referred to—Moses G. Hubbard showed this machine at Albany, N. Y., but the court ignored it under the rule tersely

stated by Dr. Knight, so equitably and so thoroughly in accord with common sense.

Alexander M. Wilson, of New York, Sept. 3, 1846, received a patent on a mower, with a cutting wheel something like that of the Bailey; and it is evident from his action that he had some conception of the importance of adjustability or flexibility in a cutting apparatus. He originally took out a patent on the same machine substantially, in 1835, and the model and records having been burned by the great fire in the patent office, 1836, he was allowed to renew his patent in 1837; but in doing so he made more prominent the adjustable or flexible feature, which, as slightly improved, in his patent of 1846, was covered by claim as follows: "I claim jointing the horse-frame to the forward part of the main frame, but back of the shaft of the cutting wheel, so as to have the horses forward and to the side of the cutter, in combination with a wheel of cutters for cutting grain or grass, so that the cutters may follow the undulations of the ground, independent of, and not affected by, the up-and-down movement of the horses, as herein described."

It is said that Frederick Nishwitz, of Brooklyn, N. Y., who took out several patents in this line during the "fifties," had invented a jointed bar mower many years before, but was too poor at the time even to get a patent, and so was compelled to let others succeed to his invention; and also that one Gerger, of Springfield, Ill., filed an application in 1849 for a patent on a hinged bar which was rejected; but as in other cases, by neglecting to complete their work, they rendered what they had done useless to themselves and to the public, and left the field still open to others.

A considerable amount of work was done in this development during 1852. Byron Densmore, of New York, Feb. 10, obtained a patent which as afterwards re-issued and assigned to D. M. Osborne and W. A. Kirby had a claim as follows: "Hanging the driving wheel in a supplementary frame, or its equivalent, which is hinged at one end to the main frame while its opposite end may be adjusted and secured at various heights, or be left free, as desired, whereby the cutting apparatus may be held at any desired height for reaping or be left free to accommodate itself to the undulations of the ground for mowing, etc." The patent became one of the Kirby system controlled by D. M. Osborne & Co. His machine had a single driving wheel, but the cutting apparatus was sufficiently flexible to render it in this respect the only single wheel mower that could compete successfully with the two-wheeled jointed-bar machines. R. T. Osgood, Orland, Me., Feb. 17, 1852, got a patent, which, as re-issued and assigned to Cyrenus Wheeler, Jr., covered two independent driving and supporting wheels on a common axle with a ratchet wheel and pawl for each, so that either could hold in gear when advanced or be out of gear when backed, a peculiarly hinged arrangement for cutter-bar and frame, a lever so that driver could raise or depress cutters from his seat while machine was in motion, a balance wheel "to equalize the motion of the cutters," and other points not necessary to mention. July 20, 1852, two important patents were granted, one to Jesse S. and David Lake, of New Jersey, and the other to Eliakim B. Forbush, Buffalo, N. Y. The first was afterwards assigned and re-issued to Jas. A.
















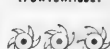




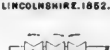











CIRCULAR MOTION.					
CONTINUOUS AND ADVANCING.					
PITT PERSEFORD. 1788. 	SMITH DEANSTON. 1811. 	MANN CUMBERLAND. 1820. 	OISEON NEWCASTLE. 1840. 	FRANCE. 1851. 	BURCH CHESHIRE. 1862. 
BOYCE LONDON. 1789. 	KERR SCOTLAND. 1811. 	BAILEY U. S. A. 1822. 	WHITWORTH MANCHESTER. 1849. 	BLACKAY SWANSEA. 1861. 	CONTINUOUS WITH ALTERNATE.
LEON WALKER PHILOST. 1799. 	CUMMING NORTHUMBERLAND. 1811. 	BUDDING CLOUGESTER. 1830. 	WHITWORTH MANCHESTER. 1849. 	MASON IPSWICH. 1862. 	
PLUCKNETT KENT. 1805. 	DOBBS BIRMINGHAM. 1814. 	CHANDLER U. S. A. 1835. 	FAIRLESS NORTHUMBERLAND. 1851. 	SMITH LINCOLNSHIRE. 1852. 	TROTTER SUNDERLAND. 1851. 
OLADSTONE SCOTLAND. 1808. 	SCOTT ORRISTONE. 1815. 	U. S. A. DUNCAN LONDON. 1840. 	WINDER LONDON. 1861. 	COMPERTZ LONDON. 1862. 	
PLUCKNETT KENT. 1807. 	SCOTT ORRISTONE. 1815. 	PHILLIPS 1841. 48 & 52. 	BECKFORD & DOOLING MIDDLESEX. 1851. 	COMPERTZ LONDON. 1862. 	

CHART SHOWING FORM AND MOVEMENTS OF THE CUTTERS OF HARVESTING MACHINES.
FROM WOODCROFT'S APPENDIX (ENGLISH).

CUTTERS WORKED BY HAND.	RECTILINEAR MOTION.				
	ADVANCING ONLY.	RECIPROCATING AND ADVANCING.			
	ANCIENT ROMAN. 	SALMON BEDFORDSHIRE.1807. 	RUNDELL U. S. A. 1835. 	Mc GORRICK U.S.A. BROOMAN LONDON.1862. 	WRAY & SON YORKSHIRE.1852.
	GLADSTONE SCOTLAND.1828. 	DOLE ALNWICK.1822. 	Mc CORMICK U.S.A. BROOMAN LONDON.1850. 	POOLE LONDON.1852. 	HARKES CHESHIRE.1852.
ISLAND OF JAVA. ANI 	ESTERLY U. S. A. 1844. 	BELL SCOTLAND.1826. 	STACEY MIDDLESEX.1852. 	CROSSKILL YORKSHIRE.1852. 	HUSSEY MANCHESTER.1852.
BEARES SOMERSETSHIRE.1800. 	BLAIRIE GLASGOW.1851. 	MANHINO U. S. A. 1831. 	DRAY LONDON.1852. 	DRAY LONDON.1852. 	JOHNSON LONDON.1852.
TAYLOR LANCASHIRE.1851. 	SIDELONG AND ADVANCING. LITTLE MIDDLESEX.1847. 	HUSSEY U. S. A. 1853. 	RIDLEY NORTHUMBERLAND.1852. 	FOWLER BRISTOL.1852. 	COMPETE LONDON.1852.
	EXALL READING.1851. 	Mc GORRICK U. S. A. 1834. 	RANDELL CORNWALL.1852. 	NEWTON LONDON.1852. 	

CHART SHOWING FORM AND MOVEMENTS OF THE CUTTERS OF HARVESTING MACHINES.
FROM WOODCROFT'S APPENDIX (ENGLISH).

Saxton, Canton, O. It had a single driving wheel, but it claimed the attachment, by double hinged arrangement to the frame of any mowing machine, of the cutter bar, "so that the guards or fingers, or that part to which they are sustained and supported, will be free to rise or fall bodily, and also to have a lateral or wobbling motion to enable the cutting apparatus to conform freely to the undulations of the ground over which it is drawn, independent of the up-and-down motion of the main frame." It also claimed lever, coupling piece, etc. The Forbush patent assigned and re-issued to Cyrenus Wheeler, Jr., as to mowers, covered the "making of the outer and inner shoes broader in front of the finger-bar," and "the bearing piece *Z*, placed between the outer shoe and guard finger, for the support of the outer end of the cutter-bar." C. B. Brown, Griggsville, Ill., Dec. 7, 1852, patented a skeleton track-clearer, which was assigned to C. Aultman & Co.

The next patent of importance in mowers was granted to Philo Sylla and Augustus Adams, Elgin, Ill., Sept. 20, 1853, for a harvesting machine. It was purchased by C. Aultman & Co., Canton, O., for a trifle, and was re issued to them in six divisions, five of which related to flexible or hinged bar devices for mowers and by priority stood at the head of the "Buckeye" mower patent system; while the remaining division, relating to harvesters, was sold for a large sum to the "Marsh Harvester" pool. The claims are too many to give in full, and it is sufficient to say that they were made to cover all that was possible, under the original patent, for double-hinged floating-bar cutting apparatus.

The patent granted to Cyrenus Wheeler, Jr., Dec. 5, 1854, set a stake by the way or marked the division line between the old and the new system of grass cutting, not so much because of the importance or novelty of the features presented as in the fact that it covered a machine that was distinctively in construction and intention a two-wheeled jointed-bar mower, and although its original cutters were discarded it stands in proper form at the head of its class—indicating specific purpose, and combining with the new, valuable old features that were but incidental to and scattered among the inventions previously noticed. An evolution had been accomplished, and although the thing turned out was rude and imperfect it had the new form, to which the inventor and others soon gave more symmetry and better action. Mr. Wheeler seems also to have had a clearly defined purpose, viz.: to develop a practical marketable mower upon the new plan; for he continued to make improvements, to take out patents therefor, to build machines and to push their introduction until the great mower business of the country had become fully established upon this basis by himself and others working in the same general direction. This first Wheeler patent formed the foundation of the "Cayuga Chief" system, and was as re-issued the first of the long line of patents which several years after were pooled and owned jointly by the leaders, in the manufacture of Buckeye, Ball and Cayuga Chief machines, when they made their great combination. To show that Mr. Wheeler's purpose was clearly specified originally it is only necessary to quote the original claim of the patent of Dec. 5, 1854. "Having the cutter-bar *h*, provided for the purpose with a socket *z* to one extremity of the arched bar *w*, by means of joints *a a* and segments *b c*, said arched bar being in its turn pivoted in

x to the main frame A , all for the purpose of giving the cutter-bar h , by means of levers y d and g , a motion independent of the frame, and both rotating longitudinally parallel to the ground, and oscillating radially from the points a a in order to adapt the same to the inequalities of the ground, or to stop its action at pleasure." This patent was re-issued Jan. 3, 1860, in six divisions—covering a laterally projecting finger-bar, hinged to one end or corner of a main frame that is free to vibrate about a gear-center, so that said finger-bar may be permitted at each end to follow the undulations of the ground, and also so that it may rock or roll in the line of its length as well as rise and fall in a line transverse thereto; and making claims for a pitman in two pieces constructed so that it would not be cramped by the movement of the finger-bar, and on other details of improvement and construction. Mr. Wheeler took out many patents—covering points relating to mowers in general and devices pertaining specially to the Cayuga Chief, either as reaper or mower, which, by the way, was a rear-cut machine, i. e., the cutter-bar was rearward of the driving-wheels.

To Jonathan Haines, Pekin, Ill., a patent was granted, Sept. 4, 1855, on a mower, which as an invention ranks with any in this class. It was a two-wheeled machine with a floating bar, and well proportioned. In the original patent the claims are: "First, the hanging of the cutter-bar to the main frame by means of the longitudinal k and transverse rods m , so that said cutter-bar may be free to rise and fall to the undulations of the ground, while it is prevented from all lateral motion. * * * Also the use of a driver's seat when mounted on ways or rails, so that the driver can at pleasure throw his weight forward or backward, to aid in balancing or relieving the cutters, as the variable character of the ground or condition of the grass may require." It was afterward re-issued so as to cover the points invented more clearly

Many familiar names will be noticed among the inventors of devices for mowing machines at this period. George Esterly, June 27, 1854, patented a track-clearer of plow shape, Abner Whitely, Aug. 22, the rolling cone for the same purpose, and Walter A. Wood, March 20, 1855, the outer wheel with its inner face conical for clearing the track. In those days Moses G. Hubbard, then of New York, was an active inventor. June 4, 1855, he claimed "the employment of the fingers to each sickle blade for the purpose of dividing the cutter force expended at each stroke of the cutter." And he also claimed making the cutter-bar (meaning the sickle-bar) of angle iron, so as to afford a shoulder against which to abut the sections, so that a single rivet would hold each. Feb. 5, 1856, Abner Whitely obtained a patent in which he claimed "changing the angle of the fingers and cutters of reaping and mowing machines while machine is in motion and the finger piece resting upon the ground."

The patent granted June 17, 1856, to Cornelius Aultman and Lewis Miller, Canton, O., assignors to Ball, Aultman & Co., was a most important one. The original claim was for "connecting the cutter-bar to the machine by the double rule joint, or the double-jointed coupling piece, B C ," etc. It was afterwards re-issued in six divisions: covering by the two first combinations in which the shoe that carries the end of the finger beam, the

hinged brace bar and hinged coupling arm are essential elements; by the two next the arrangement for holding up the bar with its hinge, hinged coupling arm and catch for the purpose of removing the mower from place to place conveniently and securely; and by the two next the ratchet-wheel, pawl and spring combination, with two driving wheels and one main gear wheel upon a common axle for holding in and out of gear, as described. Immediately following, Aug. 12, 1856, Ephraim Ball, of Ball, Aultman & Co., aforesaid, took out a patent which, although the claim only covered details of construction, showed the hinged brace that afterwards, as improved and patented, became well known to the trade as "Ball's drag-bar." Wm. N. Whitely, Springfield, O., Nov. 26, 1856, obtained a valuable patent for self-raking reaper, which was one of the first and best as a "combined" self-raking-reaper and mower. Jan. 27, 1857, M. G. Hubbard was granted a patent on a finger-bar that obtained flexibility through being attached to the frame by two flat spring braces, so that the bar could have a vertical motion independent of the frame, its motion being governed by the surface of the ground. Feb. 9, 1858, he patented an improvement on this device, and March 17, 1857, a shifting seat as specially arranged.

Between the last date and Dec. 1, 1857, when Ephraim Ball's principal patent was issued, several were granted which as re-issued became of some importance to manufacturers. Ball's patent originally had but one brief claim, as follows: "The combination of the short curved brace rod *R* with the rigid and broad angle attachment of the inclined bar *Q* to the finger-bar *P*, the whole arranged for joint operation." It was re-issued July 17, 1860, in seven divisions, with an aggregate of thirty-three claims. These several divisions and many claims covered hinges, coupling arm brace-bar, shoe and finger-bar in various combinations; the gear wheels and ratchet-wheel, pawl, spring and case for these latter in various combinations; the balance-wheel to regulate the crank-shaft; the swiveled pitman, and, in fact, all the features of what was known as the Ball mower; of which the patent drawing is a very good representation so far as it goes. It was an excellent mower and was the first of its class to obtain a wide reputation as such.

A few days after Ball's patent was issued, John Long, Massillon, O., Dec. 29, 1857, took one out that afterwards was assigned and re-issued to Whitely, Fassler & Kelly, and furnished some of the prominent features of the Champion mower. There were two divisions made of the re-issue, but the first claim of the first division covers the principal features: "The combination in a machine having two independent driving-wheels of a single drag-bar flexibly connected at its front end with the main frame forward of the axis of the supporting wheels, its rear end free to rise or fall independent of said main frame, and connected with the main shoe by two joints, one forward and the other in rear of the sickle, for the purpose of affording the cutting apparatus firm support, and permitting either end of the same to rise or fall with the undulations of the ground over which it is drawn," etc. The other claims are for various combinations—chiefly of these features, and also on the slotted retaining link and other details.

February 16, 1858, to Fred Nishwitz, Brooklyn, N. Y., was granted a patent that, as re-issued, cut quite a figure among the manufacturers of mowers.

Feb. 23, 1858, a patent was granted to Hamilton A. Parkhurst, Fairfield, N. Y., for a mower in this class, which patent was afterward assigned and re-issued to C. H. McCormick, covering features and details not noticeably important in themselves or differing much from others described. It is said, however, that this machine was constructed and used as early as 1854; if so, the inventor was much in advance of others who anticipated him in the patent office and obtained patents that influenced the trade when the pioneers were establishing it.

To Lewis Miller, Canton, O., a patent was issued, May 4, 1858, that marked an era in the history of mowers. The drawings show the clean-cut features of the invention, and that the inventor was not a novice in this work. In this machine the essential elements of a successful modern two-wheeled mower, with hinged floating finger-bar, had at last been massed. It had two supporting wheels, each of them equally drivers, and a floating-bar made short or stopping at the heel, each end free to rise or fall, with its coupling connection raised off the ground, so as to pass over the cut grass, and with levers for governing its action. The original claims are stated as follows: "I claim so hinging the bar or beam which carries the cutters and fingers to the beam *L*, as that it may be raised up, folded over, and carried upon the main frame, substantially as described. (2) I also claim, in combination with the beam *L*, hinged as described, the braces *N, S*, rigidly connected therewith, but hinged at their opposite ends, so that the beam *L* may rise and fall at pleasure, but be permanently braced in its proper position to give the cutter and finger-bars or beams, in turn, their proper working position." Nine divisions were made of this when re-issued. These covered: First, the hinging of the finger-beam to the main frame, so that it can be folded up thereon; second, hinging the coupling arm to the frame at one side of the main axle and supporting it by a brace hinged to the frame on the opposite side of the axle, in such a manner as to obtain a wide basis for bracing on a short frame, without interfering with the folding of the finger-bar, etc.; third, the combination of crank, its journal-bearing, coupling-arm and hinge of its inner end, with a hanger that is made a common support for these parts; fourth, method of folding finger-beam upon the frame by aid of the coupling-arm with lifting lever, etc.; fifth, the combination of knuckle with joints which connects finger-beam and coupling-arm, and the lever for raising beam off the ground, and of a lever to turn on a pivot and to vibrate laterally, with notches and a catch to support the lever at any required elevation, together with the coupling-arm and finger-beam, suspended to it; sixth, the arrangement of hand-lever, driver's seat and foot-lever whereby the driver may, when necessary, use both his hands and feet to raise finger-beam; seventh, the combination of spring, pawl, and the teeth with the jib and key of the connecting rod and cutter, etc.; and eighth and ninth, shoe and adjustable sole.

Between the issue of the original Buckeye patent and 1860 several others were taken out covering devices in this class of mowers, of more or less importance, by W. S. Stetson, W. N. Whitely, M. G. Hubbard, Willard & Ross, Lewis and Jacob Miller and E. Ball; but enough have been mentioned to show the steps by which two-wheeled flexible or hinged bar-mowers were

developed into practical machines. During such development they became grouped into several great distinctive systems, the leaders of which, in their order, were the Cayuga Chief, the Ball and the Buckeye. The proprietors of the patents covering, respectively, these three systems, saw that, if either should attempt to assert rights over the other, endless litigation would ensue, and that their energies, which were fully required to meet the growing demands of trade, would be uselessly expended in efforts to define patent lines that had crossed each other in every direction. To litigate they were likely to destroy both business and patents, but to pool their rights and mass them they could jointly protect each other and probably control the market; and acting upon this assumption they formed the famous "hinged-bar pool." It was a wise proceeding for all concerned. The patents, which represented most of the brain work that up to that time had been expended in producing and making practical these useful machines, were not used for mutual destruction, but for the joint maintenance of the rights which they assured to their owners, and for the protection of all who chose to avail themselves of the same, under license, at, for the time, reasonable fees. Progress was stimulated, and not stifled as it would have been had the uncertainties of tedious lawsuits been hanging over invention and trade. Improvements followed fast. Other systems grew up and expanded. Before the association, with the patents, had expired, a number of great factories had been established that were making mowers substantially perfect in construction and operation; and competition has since maintained, if it has not raised the standard of excellence, while the reduced cost of materials and increased facilities for production have brought the price of a mower down within the capacity of any person who may need one.

The names of the patent owners and inventors represented personally or by their patents in this combination belong appropriately in any history of mowers. The members of the consolidation were Cyrenus Wheeler, Jr., James A. Saxton, John DeWalt, C. Aultman & Co., and Adriance, Platt & Co., with Wm. Allen as attorney. The following patents under date of original issue belonged to the combination: Patents of Cyrenus Wheeler, Jr., Dec. 5, 1854, re-issued in six divisions; and extended seven years from Dec. 5, 1868; Feb. 6, 1855, re-issued and extended; Sept. 2, 1856, re-issued; March 12, 1861, May 26, 1863; Feb. 9, 1864, four patents; Oct. 8, 1867; Feb. 11, 1868; and owned by Cyrenus Wheeler, Jr., through assignments, patent of D. S. McNamara, June 30, 1857, re-issued, and Sept. 28, 1858, re-issued in four divisions; of E. B. Forbush, July 20, 1852; re-issued in four divisions and extended, and March 18, 1856, re-issued; of B. F. Roney, March 11, 1856, re-issued; of E. T. Ford, Jan. 1863; of C. B. Wagner, June 24, 1856, two patents; of H. G. Vanderwerken, Dec. 8, 1857; of Thos. H. Dodge, Nov. 15, 1859, Jan. 31, 1860, and Feb. 19, 1868; of H. H. Smith, Sept. 8, 1857, re-issued in three divisions; of A. J. Holman, March 2, 1858, re-issued in two divisions; of C. A. Brownlick, Jan. 4, 1859; re-issued in two divisions; of E. Jones, March 27, 1860, re-issued in three divisions; of Chas. Tinker, and I. A. Sprague, Aug. 4, 1857, re-issued; and of S. S. Bartlett, Feb. 25, 1862. Patents of C. Aultman & Co., through assignment—Sylla & Adams, Sept. 20, 1853, five of the six divisions into which it was re-issued, extended;

of Lewis Miller, June 17, 1856, re-issued in six divisions, and May 4, 1858, re-issued in nine divisions. The patents of E. Ball were also in the pool. They were dated Dec. 1, 1857, re-issued in seven divisions, and Oct. 18, 1859; and there was in the Ball list the patent granted to J. S. and David Lake, July 20, 1852, assigned to James A. Saxton, re-issued in four divisions, and extended. Saxton probably turned in also the Willard & Ross re-issues—seven divisions of patent dated Nov. 3, 1857.

Previous to the general introduction of jointed-bar mowers, the practical rigid-bar one-wheeled machines readily cut swaths five and six feet wide, but owing to the angles that the pitman had to take in relation to the jointed-bar, on account of its varying movements, it was not practicable to cut a swath more than about four feet in width. The new system brought in and established the narrow cut, and displacing the one-wheeled wide-cut machines by force of custom apparently, also displaced the two-wheeled center-draft mowers—the Eureka, for instance—which carried their width of cut without any difficulty; but during the past few years some of the old firms seem to have recalled the fact that the one-wheeled mowers could cut wide swaths, and having concluded that it was because these old cutter-bars, more or less supported, did not drag loosely and heavily upon the ground, they soon found a way to partially suspend or sustain the jointed-bar so that it also might float lightly over the surface. This is accomplished by a system of springs that transfers the weight of the cutter-bar from the ground to the driving-wheels, thus relieving the drag and down pressure and increasing the traction. With this improvement very wide two-wheeled jointed-bar mowers are now made and satisfactorily used in considerable numbers.

CHAPTER X.

Haying Tools and Machinery.

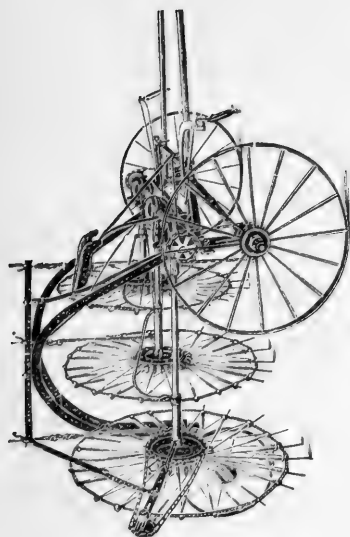
THE introduction of the mowing machine naturally created a desire for some speedier method of raking the mown hay than was afforded by the tedious hand-rake that had done duty after both the scythe and cradle, especially during the Civil war, when the use of the mower became general in the effort to supply provender for the armies. To meet this demand, inventive genius brought out the old revolving horse-rake and made it a practical implement for general use. With it the hay could be gathered quickly into windrows, and if properly handled it would rake the field clean. But something better was in store for the farmer, and in due time the spring-tooth sulky rake was perfected. With it the work could be done more rapidly and the windrows were left in better condition for loading. As made to-day the hay rakes of the sixty or seventy manufacturers engaged in this line in the United States are substantially alike in general principles and construction. There are two classes, however, the hand-dump and the self-dump, the former being operated by a lever and the latter by a foot trip throwing into connection a ratchet in the wheel to raise the teeth and leave the hay in the windrow.

The Walter A. Wood Co., of Hoosick Falls, N. Y., have been pioneer manufacturers in this line, making both hand and self-dump rakes, and we may safely illustrate their machine without causing jealousy on the part of others who make just as good an implement. Their self-dump rake has wood or steel wheels, as desired, and wooden axle, the teeth being raised for dumping by an "internal wheel ratchet" engaging the wheels at each side and causing their revolution to lift the frame that holds the teeth. The trip for operating the dump is under the foot of the driver. The thills of the ten and twelve-foot rakes are so made that they can be moved to the center to form a pole for two horses.

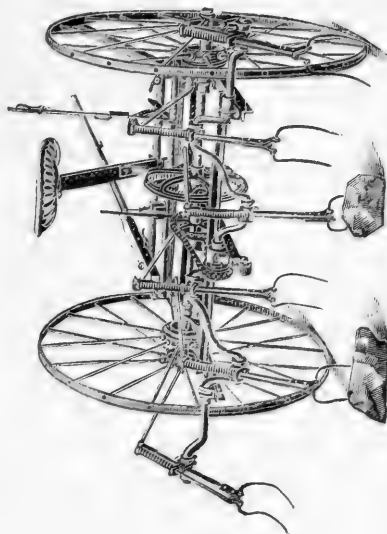
SIDE-DELIVERY RAKES.

The side-delivery hay rake is an invention brought out in recent years to be used in connection with a hay loader. It is difficult to rake the hay with an ordinary sulky rake so that it will lie in long windrows convenient for the hay loader to take it up, and inventors have been seeking a new form of rake that would leave a continuous windrow at the side.

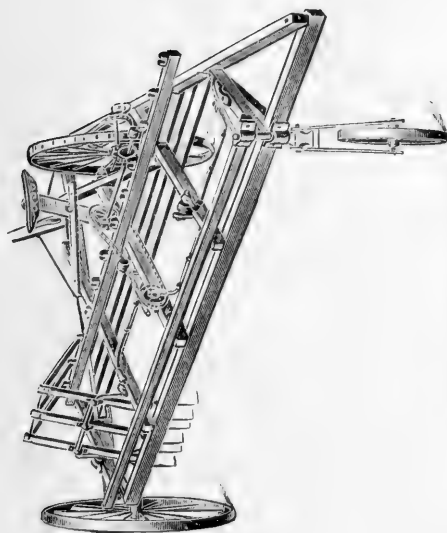
One of the first implements of this class to be brought out was the side-delivery rake of the Chambers, Bering, Quinlan Co., of Decatur, Ill. It is arranged, as shown in the illustration, with a crank-shaft resembling that of a tedder, but running forward diagonally. Mounted on this shaft are kick forks arranged in gangs of three, there being four such gangs in all. As



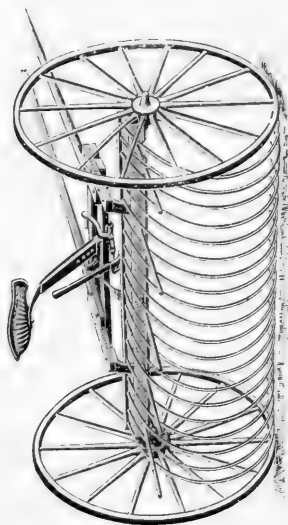
THE BECK SIDE DELIVERY RAKE.



THE OSBORNE ALL STEEL HAY TEDDER.



THE C. B. & O. SIDE DELIVERY RAKE.



THE WALTER A. WOOD HAY RAKE.

shown, the shaft is operated by gearing and a link belt from one of the forward wheels.

The Beck side-delivery rake, which has been put on the market by the Stoddard Manufacturing Co., of Dayton, Ohio, is decidedly novel in its principle and construction. It has three raking reels, which operate in series and carry the hay to one side. The fingers are long, elastic spokes with a hub set below the line of the driving-shaft, from which motion is transmitted to the spokes by a driving-wheel that acts on each spoke separately through a loose sliding thimble to carry it forward. Its operation can be better understood by reference to the illustration.

HAY TEDDERS.

There are few implements that give more general satisfaction in use or that are simpler in construction and operation than the hay tedder. The idea of the implement was no doubt conceived by some farmer or farmer's boy as a means for shaking up, by horse power, hay that had lain out in the rain and needed turning so the sun could cure it. But when the tedder had been developed into a practical implement it was found that it had a wider field of usefulness. In mowing, the horses and machine must needs pass over the grass that has been cut, packing it down more or less, and if the hay is left in that condition it dries but slowly and imperfectly, always leaving the under part of the swath damp or only partially cured. As in the case of the hay rake, it is difficult to select a tedder for illustration from the fifty or more that are on the market. However, D. M. Osborne & Co., of Auburn, N. Y., who are pioneers in the manufacture of mowing machines, have lately brought out a tedder that is made entirely of steel. The frame of this tedder is of angle-steel bar, light in weight but of ample strength. The axle is of one and one-fourth-inch steel and is provided with ratchets and pawls in the wheels. It has a steel crank-shaft which derives its power from a gearing placed on the middle of the axle. Altogether, the implement is neat and practical in its design and a fit companion of the all-steel hay rake, which this house recently brought out, the first of its class.

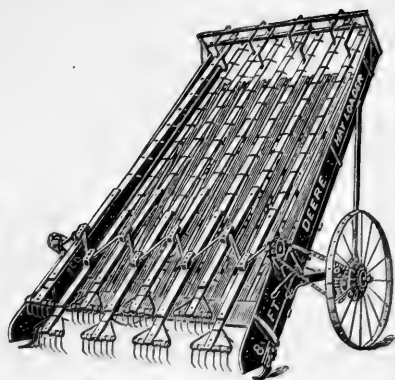
HAY-LOADERS.

Efforts to produce a practical hay-loader have been made by scores of inventors during the past generation, but until recent years there has been no demand among the farmers that would warrant the manufacture of such an implement on a large scale. About twenty years ago the Keystone Manufacturing Company, of Sterling, Ill., began experiments in this line and brought out the pioneer implement in its class. As will be seen, it is mounted on two wheels and is made to be drawn after the wagon. It has a cylinder with bars carrying hooks like the tines of a pitchfork, designed to lift the hay from the ground and deposit it upon an endless carrier or apron which elevates it to the wagon. The weight of the loader gives it two supporting wheels sufficient tractile power to operate the cylinder and elevator. It is claimed that with it a load can be taken from the windrow in five minutes.

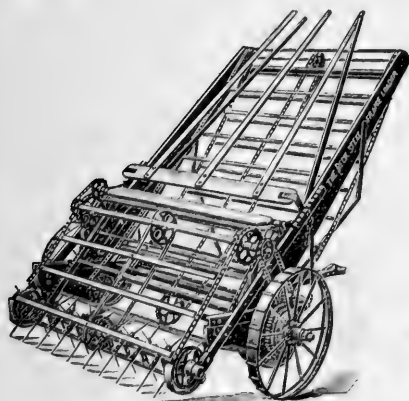
The Deere hay loader, recently brought out by the Deere & Mansur Company, of Moline, Ill., works on an entirely different principle. It consists of a series of rakes, so mounted upon a crank-shaft that they grasp the



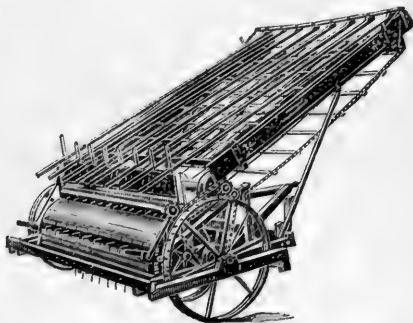
THE DEERE LOADER IN OPERATION.



THE DEERE HAY LOADER.



THE BECK HAY LOADER.



THE SANDWICH "CLEAN SWEEP" HAY LOADER



THE KEYSTONE HAY LOADER.

hay in the swath and draw it a short distance forward on the frame of the loader by the peculiar alternating movement of the rakes. The hooks on the under side of each rake gradually carry the hay to the top of the elevator, where it falls over in a cataract on the wagon. It is simple in design and effective in operation, and has met with a favorable reception.

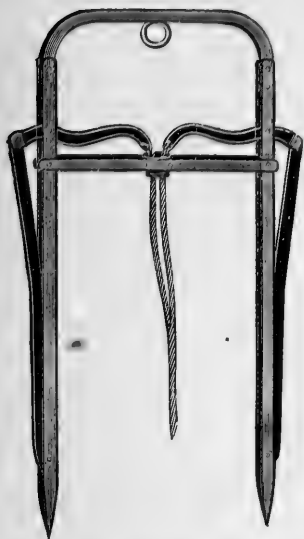
The Beck hay loader, a companion implement to the Beck side-delivery rake, previously noticed, is made by the Farmers Friend Manufacturing Company, of Dayton, Ohio. It has, in common with other loaders, the two carrying wheels from which power is derived by gearing to operate the loader. The hay is gathered from the swath or windrow by a revolving rake and elevated a short distance by an endless carrier, the latter dropping it upon a long carrier by which it is elevated and dropped upon the wagon.

HAY FORKS AND CARRIERS.

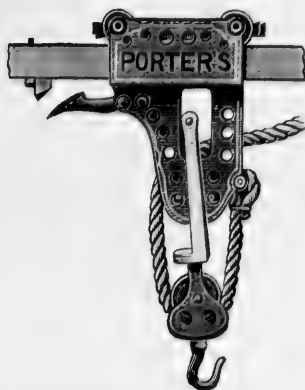
The hay fork and carrier for taking away hay in barns, or for use in stacking it in the field, followed in the procession of other improvements that began about thirty years ago in this industry. The first step that was taken was in the development of a harpoon fork. A patent was issued in September, 1864, to E. L. Walker, and other patents in the two or three years succeeding, which laid the foundation for the Nellis single-harpoon fork, Mr. Nellis patenting, in 1873, a locking device that is now in general use on this style of fork. Another hay fork, which is known in the trade as the Walker, was patented by E. L. Walker, in 1868. The double-harpoon fork, generally known as the Harris, was patented in 1867 by S. & E. Harris. Several patents were issued in the "sixties" that laid the foundation for grapple forks, which, however, have been modified in construction from the ideas of their first inventors, making them more simple and effective.

At first, hay forks were used without carriers, but inventors were not long in bringing out tracks and carriers by which the hay could be deposited at a distance from the wagon. J. E. Porter, of Ottawa, Ill., was a pioneer in this line, having begun in 1869, using at first an iron rod for the track, or a common 2x4 scantling. In 1872, Mr. Porter patented improvements that gave considerable impetus to the demand for hay carriers, and has since added many valuable features. Other inventors have also been at work in the field, and the records of their efforts are so voluminous in the Patent Office that it would be difficult to point out the various steps followed by the evolution of the trade.

Within the past ten years various forms of steel track have been perfected for hay carriers. In 1883, Jacob Ney, of Canton, Ohio, patented a track, consisting of two horizontal pieces of angle-steel, one flange being set vertically with the supporting rods or hanging hooks attached to it, and the other forming a horizontal track for the wheels of the carrier. The joints were made with clamps or fish plates. In 1886, P. A. Myers, of Ashland, Ohio, patented a track formed of two T bars, placed side by side, held by upper and lower clamps and with connecting bolts passing vertically through the clamps. The suspending rod or cylinder hooks are inserted between the beams at convenient places. In 1887, J. E. Porter, of Ottawa, Ill., pat-



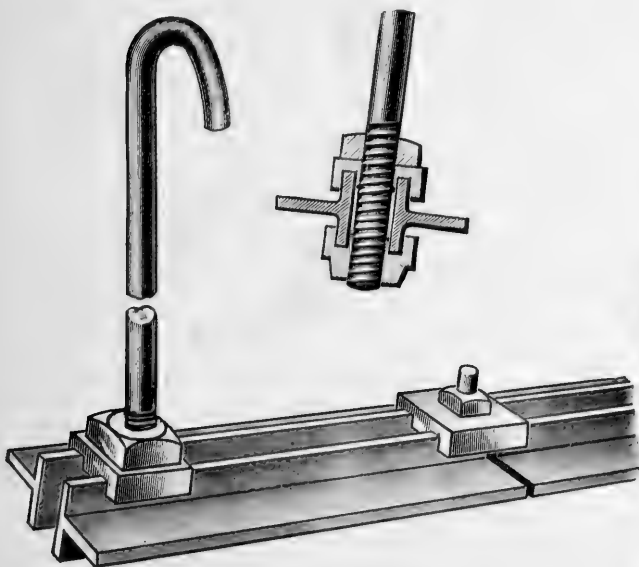
THE HARRIS DOUBLE HARPOON FORK.



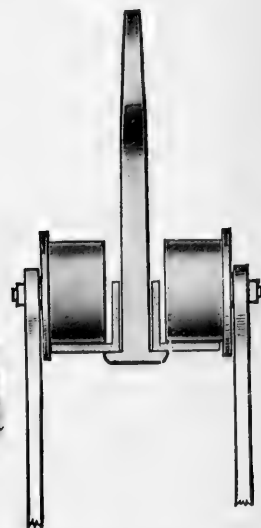
PORTER'S HAY CARRIER.



THE NELLIS FORK.



THE MYERS DOUBLE RAIL STEEL TRACT



THE NEY STEEL TRACK.

ented a form of solid steel rail, and he has also obtained a recent patent on a single rail with a flange on each side to support the carrier.

BALING PRESSES.

The many patents granted on baling presses during the early half of the present century show that inventors began early to wrestle with the problem of making up hay in compact bales for transportation. It seems, however, that no one was able to create a demand that would warrant the manufacture of this useful machine until, in 1853, H. L. Emery, of Albany, N. Y., began the manufacture and sale of a crude form of horizontal press, in which levers attached to plungers in each end of the baling chamber were operated by chains and pulleys. It was awkward in appearance and in operation it was only capable of making five 250-pound bales per hour, requiring two men and a horse to operate it. It made a bale 24x24x48 inches.

Soon after this first effort, in 1859 or 1860, P. K. Dederick, of Albany, became interested in the hay press. Mr. Dederick acquired the patterns and business of a series of efforts that had begun years before, and continued his experiments until he had brought into practical form a press for general use. In 1872 he invented a continuous form of press, which has since come into general use. George Ertel, of Quincy, Ill., was the pioneer in the west in the manufacture of hay presses. His first effort in this direction was in 1866, when he made a vertical press to be operated by horse power. Soon after he gave his entire time to the development and manufacture of hay presses and contributed many valuable improvements.

About ten years ago steam power presses were introduced and came into general use in response to a demand for greater baling capacity than was possible with horse power. The latest improvement looking to an increase of capacity is a self-tying device, introduced by the Famous Manufacturing Company, the pioneer house in the west among the manufacturers who were at the Columbian Exposition.

The manufacture of hay presses has become an important industry, one that was well represented at the Columbian Exposition by the exhibits of eight or ten manufacturers.

CHAPTER XI.

Threshing Machinery.

IT is probable that at first the little grain that was raised was shelled by hand, but as the quantity increased the kernels were whipped from the heads across sticks or poles or pounded out by a staff or rod. In Isaiah, xxviii., 27, 28, we read: "For the fitches [peas] are not threshed with a threshing instrument, neither is a cast wheel turned about upon the cummin [a seed-plant something like caraway]; but the fitches are beaten out with a staff and the cummin with a rod. Bread corn is bruised, because he will not ever be threshing it, nor break it with the wheel of his cart, nor bruise it with his horsemen."

Here we have several methods of threshing indicated; peas and seeds from plants were beaten out by a staff or rod, while the grain crops required something more expeditious and elaborate in construction, designated a threshing instrument; but the cleaning was accomplished by winnowing; i.e., by tossing up the threshings, after the straw was raked off, so that the wind might blow aside the chaff and dirt. A club was at some early time attached to the staff, and thus the flail was invented.

Cattle were generally used by the ancients to tread out the grain spread upon the "threshing floor"—referred to in Deuteronomy, xxv., 4: "Thou shalt not muzzle the ox when he treadeth out the corn"—and also to draw around over the grain the *charatz* of the Egyptians and the *moreg* of the Hebrews, the former having been something like the "stone-boat," which is used on farms east for gathering stones, but made rough on the bottom. The latter consisted of a sled-like frame between the runners of which spiked cylinders were placed that revolved upon the grain as the rude implement was drawn around. Similar devices were known to the old Romans, by whom they were called *traha* and *tribula*. Something of this sort is still used in eastern countries and in Italy, but one of the common methods of threshing there is by means of large fluted rollers or beaters revolving upon a long horizontal shaft or sweep, one end of which is attached by a ring around a post set in the center of the circular threshing-floor, the cattle being hitched to the outer end. As they move around outside of the grain spread upon the floor the rollers turn upon the shaft and beat out the grain.

The flail has been known among the Japanese from the earliest times, according to their records; either used singly for threshing grain from the straw, or in connection with a stripper, called by them *mogi-kogi*. This latter is a large comb, with teeth of iron or hard wood. The Japanese implement is attached to a frame or bench, the teeth pointing upward. The grain, after being first reaped, is brought to it, and the heads are stripped

or combed off between the teeth by being drawn through by hand. The headings are gathered up and carried to a threshing floor, where the kernels are beaten out by flails. The grain is cleaned by winnowing or by screening.

Michael Menzies, of Scotland, is supposed to have been the first inventor of a power threshing-machine, for which he obtained a patent in 1732. This was a contrivance arranged to drive a large number of flails by water-power. It is described as a wonderful invention and "capable of giving 1,320 strokes per minute, as many as thirty-three men threshing briskly"—decidedly indefinite; and as "moved by a great water wheel and triddles." The grain was brought to this machine as it was to others invented and used during the last century and the early part of this, before portable threshers were introduced. The flail motion was not practicable, and was soon abandoned.

The first practical effort leading in the right direction was made by a Scotch farmer named Leckie about 1758. He invented "a rotary machine which consisted of a set of cross-arms attached to a horizontal shaft, and the whole enclosed in a cylinder case." It threshed dry oats very well, but knocked off wheat heads, and, while it was not practical as constructed, it demonstrated the superiority of the rotary motion and pointed out the road to success.

The first successful threshing-machine—the type of modern threshers—was invented by still another Scotchman, Andrew Meikle, in 1786, and patented in 1788. In this "the grain in the straw is fed from the board *A*, between two fluted rollers *B*, to the beater-cylinder *C*, thence passes to another beating-cylinder *G*, which operates over a concave grating; a third cylinder *H* raises and loosens the straw which parts from its grain *F* through the concaves, and the straw is delivered at *K*." Circular rakes or beating-cylinders were added in 1789, but a fanning-mill was not provided till 1800, when at last a complete "separator" was produced, threshing, cleaning and delivering the grain at one operation. Still these machines were "stationary," being generally put up in buildings, and the grain was drawn to them.

In a work describing the "Implements of Husbandry Used in Scotland," by Andrew Gray, engineer, published in 1814, is a description of a threshing-machine which seems to have been a complete separator to be driven by two horses attached to a stationary power. Except that it was not portable, it had all the general principles of a modern separator, even to grading the grain, delivering two qualities while in operation—on one side the heavy kernels, on the other the light, or screenings. The inventor's name is not given.

It has been generally supposed that the threshing cylinder was first invented and perfected, next the straw-separating devices, and then the cleaning, and that thus one thing after another was invented and applied until the present perfection had been attained, but early inventors of threshing-machines, both in Great Britain and in this country, like those of reapers, reached too far at first. They covered the whole ground in theory before any main features had been made practical; hence the combination of a number of undeveloped principles, working imperfectly of

course, rendered the whole too difficult to manage and unfit for general use. Afterward open-cylinder threshers—called “chaff-pilers” by some, “bob-tails,” “ground-hogs” and “bull-threshers” by others—were made and put upon the market successfully. About this time “traveling threshers,” which went around the fields after the grain, were used to some extent. These opened the way for those that carried the separating attachments, which latter were improved as use pointed out the necessity until, having become practical throughout, the “separator” absorbed the trade to the exclusion of the older or simpler forms of thresher, and further development has separated the “separator” into several different classes, each of which has been substantially perfected.

All the early threshers were stationary. They were set up in barns or other buildings, and the grain was brought to them like grists to a mill. Sometimes they were driven by water, but generally by what have been called cider-mill horse-powers. These were usually under cover, and were very simple in construction, consisting generally of a center-post, or spindle, pivoted at bottom and top in beams, with long sweep attached, and carrying a very large horizontal master-wheel, generally overhead, which drove a pinion and shaft and transmitted the power by a belt or tumbling-rod to the thresher. The next idea was a traveling thresher with harvesting attachments or without, and these obtained power for their operation from the traction of their ground wheels as they were hauled around the fields. About this time tread or railway horse-powers were introduced, and soon after sweep-powers came into use.

It is possible that some of the early threshers of British make were brought to America or that others similar were made in this country quite early in the century. It is said that “bull-threshers” were used as far back as 1825 or farther, but there is no trace of substantial improvement in them until Aug. 8, 1828, when Samuel Lane, of Hallowell, Maine, patented a traveling thresher with harvester attachments. Another patent was granted to him April 6, 1831, but both were unrestored. The first had an apron carrier, and cut some figure in the suit between Pitts and Wemple many years after. Lane was an ingenious inventor, but unsuccessful, and died poor in 1844.

The Pitts brothers—Hiram A. and John A.—of Winthrop, Maine, were the first American inventors who were successful and practical in this line, whose inventions went into general use and have come down to this day. H. A. Pitts, in 1830, patented an improvement on a railway or tread power, which consisted in the substitution of hard maple rollers under the movable platform, connected by an endless chain, for the old-fashioned leather belt. He and his brother, John A., began the manufacture of these improved powers on a small scale in their native town, and introduced them in the state of Maine and to some extent in other New England states. They became popular for giving power to the “ground-hog” thresher, as the open-cylinder machine was called there. While operating these machines, H. A. Pitts conceived the idea of combining the old “ground-hog” and the common fanning-mill in a portable form. In 1834 he completed a machine on this plan which operated successfully. After various improvements had been

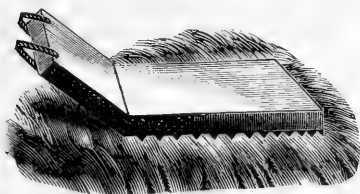
made by him and his brother during the intervening years, a patent was granted to them, Dec. 29, 1837, for their thresher, which was the original of the great family of "endless apron" or "great belt" separators. This first machine, though quite different in appearance from those of the class as constructed at the present day, had all their essential features. It did not have a "second carrier" or open raddle; the apron ended at the picker; the beater was round and armed with pegs; the picker was of the same form, but smaller, and its office was to throw the straw off from the machine; and the elevator did not return the tailings to the threshing cylinder, but emptied them into the sides of the machine over the return board or sieves for re-fanning.

The invention of the Pitts brothers marked a distinct era in the history of threshing machines; and although various improvements have been made in the details of this type of threshers, it is a remarkable fact that they followed the principles covered by the original patent all the way down for more than half a century. They manufactured these machines in company until 1840, when John A. Pitts went to Albany, then to Rochester, N. Y., where he connected himself with Joseph Hall, another pioneer. Next he went to Springfield, Ohio, and finally to Buffalo, N. Y., where he died in 1859.

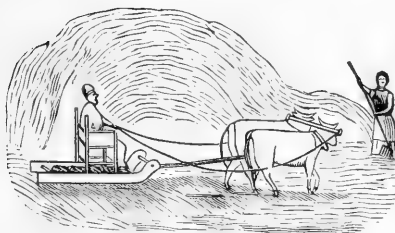
Hiram A. Pitts remained in Maine until 1847, when he removed to Alton, Ill., where he began the manufacture of threshing machines. He built a good many at that place, improving and perfecting them from year to year. In 1851 he removed to Chicago, and in 1852 put upon the market his first threshers from that point. During the years following a large trade was established, and his machine, known as the "Chicago Pitts," found a market wherever grain was raised to any extent. He died in 1860.

Returning to the patent record, we find that Feb. 5, 1836, E. Briggs and C. G. Carpenter patented a traveling thresher which could be used with or without a grain-cutting attachment. It ran on four wheels, like wagon wheels, and depended upon the traction of the two hind wheels for power.

About 1830 Jacob V. A. Wemple, of Montgomery county, N. Y., a blacksmith and wagon-maker, became interested in threshing machines on account of repairing some of the crude machines in use then. He invented an open-cylinder or "bull-thresher" and a horse-power to go with it, and began manufacturing at Mineyville, N. Y. The peculiarity of the thresher was in the shape of the cylinder teeth and in the manner of fastening them to the cylinder. The horse-power was of the stationary type. About 1840 he entered into partnership with George Westinghouse, whose son was since the inventor of the celebrated air brake for railroad cars. Together the two inventors and mechanics worked out a separator differing somewhat from that of the Pitts brothers', in this chiefly, that it had a short-slatted canvas carrier that delivered the threshings upon a traveling sieve or riddle, which was given a vibratory movement by running over square tumblers or rollers, the grain and chaff shaking through, the straw being carried over. They obtained a patent for this machine, which was afterward known as the Wemple thresher, July 13, 1843. They were then manufacturing at Fonda, N. Y. Mr. Westinghouse soon after withdrew, going first to Central Bridge and



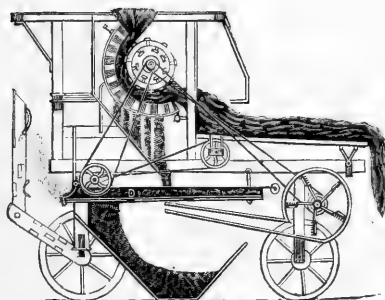
THE CHARATZ OF EGYPT.



THE MOREG OF THE HEBREWS.



JAPANESE "STRIPPER."



EARLY ENGLISH SEPARATOR.

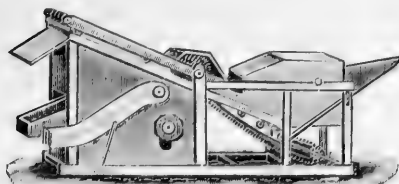
afterward to Schenectady, N. Y., where he permanently established himself. He continued manufacturing threshers, after the Wemple principle, for many years. He also built at an early day an open-cylinder "ground hog" thresher with a vibrating separating attachment. He died in 1844.

Mr. Wemple came to Chicago in 1848. He made and put out his machines successfully up to and including 1852, when he sold his shops to H. A. Pitts and retired from the business personally, leaving it to his son, Andrew, and a Mr. Kline, who continued under the name of Wemple & Kline until the general crash of 1857, when they went down with many others. Mr. Wemple died in 1873.

There was no difficulty in getting most of the grain from the straw with the early plans for separation, but all the while the strife has been to provide devices the best and surest to save the little left. The early British machines and those of the same type constructed in this country sought to accomplish this by combined beaters and pickers, which beat and tossed the straw along over concave grates or stationary riddles, through which the grain fell. It is claimed that about all the grain was obtained by these devices. An improvement was inaugurated and established by Pitts, whose general plan was to carry the threshings along upon an endless ascending belt, having more or less of a vibratory or jarring motion while running, by which the grain was caused to settle through the straw, the process being aided by pickers and beaters operating upon the moving mass. These principles, when fully developed, seemed to be capable of saving substantially all the grain. But perfection had not been attained, and a series of experiments upon still other methods of separation culminated in what is commonly recognized as the "vibrator."

Early in the "thirties" Pitts used a perforated board or platform, which was shaken longitudinally, in connection with the "ground-hog" thresher, while experimenting, and before the adoption of the endless apron. Geo. Westinghouse, at a later period, used a pan in a similar manner. There is no doubt that separating devices to be shaken longitudinally were attached to the old "ground-hog" or "bull" thresher, at various times before separators, as a class, were generally used. A patent was granted to W. Pierpont, of Salem, N. J., May 7, 1850, on this principle; but Cyrus Roberts, then of Belleville, Ill., was the first to invent and carry forward to successful completion devices necessary to the development of the modern vibrating type of threshers.

It seems that John Cox and Cyrus Roberts commenced to build tread-powers and "ground-hog" threshers at Belleville along in 1848 or 1849. During the second year they added a vibrating pan or separator, to take the place of the forkers and the men who pitched the straw away. This addition to the machine was set on legs, loosely, so as to vibrate backward and forward by the action of a crank and pitman attached. It was made of lumber, consisting of side-boards and a plain bottom the width of the cylinder, six to ten feet long, and bored full of holes. The vibration caused by the crank motion shook the grain and chaff through these holes, making a partial separation only. It did not dispense with the forkers, as they still had to help get the straw away with their forks, but it assisted mate-



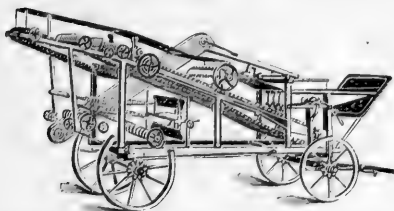
PITTS MACHINE AS MADE IN 1838.



WESTINGHOUSE "GROUND-HOG" THRESHER.



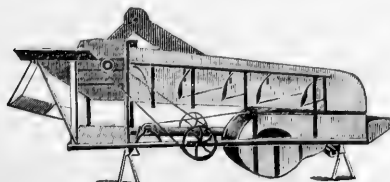
OLD WEMPLE THRESHER AND HORSE POWER.



THE SWEEPSTAKES THRESHER, PITTS' SYSTEM.



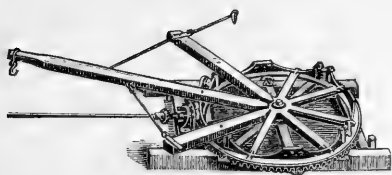
COX & ROBERTS' VIBRATING THRESHER, 1852.



NICHOLS & SHEPARD'S FIRST VIBRATOR, 1858.

rially in the operation of separating and dividing the grain from the straw. There was no fanning mill as yet to the machine, no frame-work, decking nor covering, but in a short time a frame was added, and to this the vibrating pan or separator was suspended by rods. Other improvements were made, and, July 20, 1852, Mr. Roberts obtained a patent on the machine, the first claim of which was as follows: "Having thus described my improvements in grain separator and cleaner, what I claim therein as new, and desire to secure by letters patent, is the combination of the adjustable crank for vibrating the separating trough with the adjustable tracks on which the jumping roller runs, which shakes the trough up and down, whereby the straw may be accelerated or retarded without affecting the vertical shaking of the straw." March 25, 1856, they obtained a patent for the shaking fingers, which had been added meantime. This thresher was developed into a first-class machine, known at first as "Cox & Roberts' thresher." The Cox & Roberts' thresher was also manufactured by Kingsland & Ferguson, of St. Louis, Mo., who were among the first to adopt this principle, and were prominent in the early struggles to develop and establish it. A few years after Mr. Cox sold his interest in the business, and in 1857 Mr. Roberts also sold out, and afterwards went to Three Rivers, Mich., where he resided until the time of his death, the past summer.

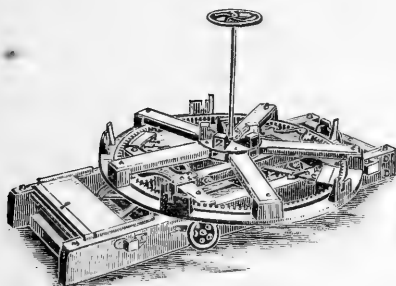
The development of the Cox & Roberts machine was slow, and no great headway was made in the establishment of the principle until in 1858, when Nichols & Shepard, who had been manufacturing agricultural implements at Battle Creek, Mich., since 1848, commenced to build threshers upon this vibrating principle. Their plan was to let the straw pass from the threshing cylinder directly upon successive ranks of lifting fingers, to which was imparted a sudden up and down motion, by means of which the straw was thoroughly agitated from the moment it left the cylinder until it reached the end of the machine. Their first separator had but one "shaker." It gave good promise, but, of course, was more or less crude and defective in operative qualities. John Nichols gave the machine the trademark name "Vibrator," and devoted his attention particularly to the details of its development. The next year, 1859, "double shakers" were put in the machine. They counterbalanced one another, thus stopping the end-shake, and they also greatly assisted in separating by allowing the grain to drop through the slatwork of the upper shaker into the conveyor-shaker below. At this time the cylinders were built of wooden staves bolted to iron heads, the teeth (of the old form, patented many years before by Fox & Borland) being driven in, or of wrought-iron bars provided with teeth and attached to cast-iron heads and center-piece. Usually but six bars were used, and it was found that the bars, with their teeth, were too far apart, causing the straw to be jerked from the hands of the feeder and carried through before being threshed clean. They then adopted the iron cylinder, but added more bars until they built the "twelve-bar cylinder." They kept on building and improving their vibrator, encountering and overcoming many obstacles in construction, until 1864. About this time the machine attracted the attention of H. H. Taylor, of Chicago. He had long been the most extensive dealer in threshing machines in the United States, and had just obtained an inter-



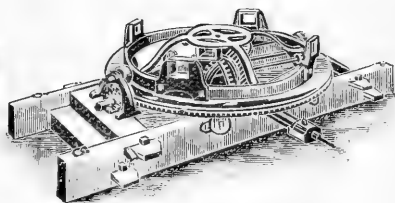
OLD STYLE, SINGLE GEAR POWER,
USED BY PITTS.



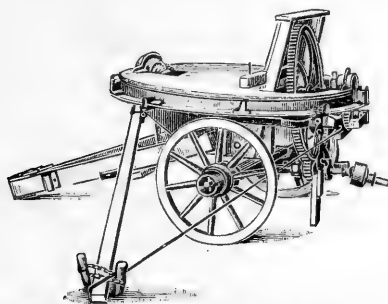
PITTS-CAREY POWER, MOUNTED.



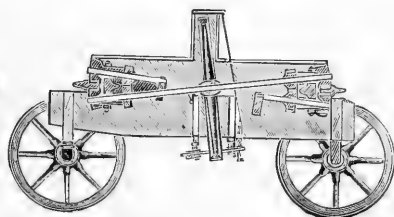
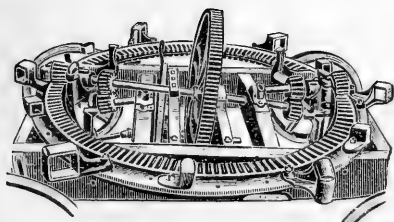
DOUBLE PINION PITTS-CAREY POWER.



J. I. CASE'S CLIMAX POWER.



WOODBURY POWER ON TWO WHEELS.



THE DINGEE-WOODBURY POWER.

est in the Marsh harvester, then at the opening of its career, for the purpose of widening his business in that direction. After a careful investigation of the merits and prospects of the vibrator, he was so favorably impressed that in 1865 he negotiated with Nichols & Shepard and obtained an interest in their patents and shops, meantime disposing of his interest in the harvester. This reinforcement added vigor to the contest and struggle for supremacy between the new principle and the old types of machines. A year or so after, C. Aultman, of C. Aultman & Co., Canton, O., manufacturers of the then celebrated "Sweepstakes" threshers, bought an interest in the vibrator patents, and in connection with Mr. Taylor established the Aultman & Taylor Company at Mansfield, O., in 1867. This consolidation of interests told heavily upon the ranks of the old system. One by one its supporters gave way, until at last substantially all had capitulated or had fallen into line under the new dispensation. Mr. Taylor died in the heat of the contest, and Mr. Aultman after it had ended.

In the foregoing full credit has been given the originators of and leaders in the vibrator movement for the conception and establishment of the general principle; but it is not to be supposed that perfection had been attained by them in the first few years, or that the restless energy of genius would stop there. When a new system or principle has been developed to success and general acceptance, immediately invention seeks to provide improved methods or better plans for applying the same. Some of these changes may be but in form, others in both form and principle, while still others may advance by evolution so far from the original type as to lose their identity therewith, and thus it has been in the development of threshers since the vibrating system was established.

POWERS FOR THRESHING MACHINES.

Previous to 1830 several kinds of crude stationary powers had been constructed and used for threshers, and tread (since called railway) powers had by that time become quite practical. These latter were soon after constructed so as to be portable; and the advantages of this principle being obvious, inventors and manufacturers thereafter adopted portability as a chief feature.

It was a simple process when portability became essential to take down the big wheel and pinion of the old stationary power, to arrange frame and levers, and to extend the horizontal rod along the ground, so that horses might travel over it. Then, when the toothed cylinder was substituted for the old-fashioned barred drum, to provide the increase of speed required through an intermediate gear, that is, to add what is known as the "jack." After a portable lever-power had been blocked out, so to speak, its use would readily point out necessary improvements; and as use increased and powers multiplied different makers would naturally travel in different directions in the application of such improvements.

Probably the first down-power was simply a large bull-wheel and a single pinion. It might have been either a spur or bevel-gear, as both had been used on stationary powers. As far back as 1800 a spur master-wheel and pinion, with a pair of bevel-gears connected for increasing speed, all overhead, had been used in a stationary power for a threshing machine, hence

one method, at least, of increasing speed in the power itself was pointed out; but it required considerable invention and mechanical skill to get these crude ideas into a successful portable lever-power.

Doubtless several kinds of fairly practical powers were constructed and used before any showed sufficient superiority to create a type, and probably they were nearly or quite all of the low speed, that is, requiring jacks to give sufficient motion; but as with the "separator" so with the power, it seems that the Pitts brothers were the leaders. At any rate the Pitts power was the first to gain general use and to maintain its position, as improved, of course, in the market down to the present day.

Powers designated by their motions are of two classes—the low and the high speed. The first requires the jack to increase motion, and the second furnishes sufficient speed direct; but this is quite an indefinite distinction, because compound gears, and the rate of speed which may be given by the gears or the cylinder, afford wide scope in the construction of the power itself, so that the line between the two types may not be strongly marked. These powers for threshing machines are now obsolete, but for other purposes are very useful, and are generally manufactured. Of the early high-speed powers the Planet, the Woodbury, the triple-gear and the Climax were the leaders. The first lever-power used by the Pitts brothers had the large master-wheel and single pinion with jack; but they were experimenting upon the Climax, so-called, about 1845, when Mr. Carey, who was working in the same room with H. A. Pitts, suggested using two pinions instead of one for the two bevel-wheels in the center to prevent heat and wear. The result was the internal gear and the turning of the bevel-wheels down, and thus the foundation of the Pitts-Carey power was laid. Mr. Carey made no claims to the invention at that time, but the Pitts brothers, in honor of his suggestion, had his name signed to the application for patent, taking assignment in full; and afterwards they paid him \$500, which he thankfully received. The original iron bridge which joined the two pinions proving too rigid, the Pitts brothers put on their movable step and adjustable cap to hold both top and bottom of bull-pinion and bevel-wheel. This they patented in 1846. The Pitts-Carey combination became a popular power at once, and retained its hold under various modifications, constructions and names. They were not mounted at first, but had that distinction at an early day, and have been frequently improved in accordance with current requirements.

The triple-gear is a high speed type of power, and is put out in various forms according to the uses required of it. Its principles are plainly shown in the illustration, and so are those of the Climax.

The Woodbury power has had from the first marked peculiarities. Its construction was such that it could only be used as mounted, for which reason, perhaps, it led in the introduction of mounted powers. It rode into the market on two wheels along in the forepart of the "fifties," but did not gain ground very fast, owing to its liability to break; but later, as constructed at Springfield, Ohio, at Racine, by J. I. Case, and by other careful manufacturers, it gave satisfaction. Later on it was mounted on four wheels, and was improved and strengthened, so that it had become a sturdy competitor with

the Pitts-Carey, the Climax and the triple-gear types, but it was still supposed to lack the strength and durability required for the larger styles of separators. The original Woodbury had but two driving pinions for the master-wheel, one above and one below, on either end of the shaft, upon which was the big spur-wheel; the others were traveling pinions simply. W. W. Dingee, a skillful mechanic and an inventor in this line, remodeled the power by making the idlers working parts of the power, thus putting upon four pinions the strain and wear that previously had been applied to two.

PORTABLE AND TRACTION STEAM ENGINES.

The use of steam power for agricultural purposes began in England almost half a century ago. Patents had been granted more than a century ago to Watt and others on steam engines of portable or traction form, and nearly all the essential elements of portable threshing engines had been invented long before threshers had become well enough known for practical men to operate them by steam power.

In 1850 Horace Greeley mentions in the New York *Tribune* that he had seen at Watertown, N. Y., a portable steam engine for farm use, and his comments upon its work would indicate that but little was known of such engines.

During the Civil war the high cost of iron and steel made it impracticable to put on the market engines for threshing purposes at a price within the means of farmers and threshermen, and it was not until several years after that manufacturers of threshing machinery turned their attention seriously to building them. As soon as the success of steam threshing was demonstrated, they brought out portable engines, at first of six and eight-horse power, but later on of greater capacity, as the trade demanded. The most important improvement that was made was in the development of a durable traction gear, but many minor inventions have been added. An important step was taken when a form of fire-box was brought out adapted to the use of straw as fuel instead of coal or wood.

CHAPTER XII.

Corn-harvesters.

THE harvesting of corn is one of the problems that our inventors and manufacturers have long sought to solve. Forty-three years ago the first patent in this class was granted to Edmund W. Quincy, of Illinois, who has, since that time, become well-known throughout the country as "Old Father Quincy."

There are two stages in the development of any implement. The first covers the conception of the idea and the making of an "operative" implement—one that does its work satisfactorily in the hands of the inventor or others who handle it carefully. The second stage covers the pioneer efforts to manufacture it and to introduce it into general use. For example, many inventors during the early part of the century had reapers that were "operative," but it was not until 1846 that they had become sufficiently practical to be made and sold in large numbers. Again, inventors began about 1850 to study out the problem of a self-binding harvester, and many machines were made that would work well in the hands of inventors, but it was twenty-five years before they had become perfect in design and operation so they could be manufactured for general use; and during this time as much capital was lost in fruitless efforts as there is invested in the industry at the present time.

There are, to-day, several corn-harvesters that work successfully in the field when handled carefully, but whether they have reached the final stage of development so they may be put on the market in large numbers, no one can predict. An encouraging feature is that these machines are in the hands of the large manufacturers of twine-binding harvesters, who have ample capital to carry the work through to success.

"Old Father Quincy's" first machine was essentially a field-picker. It was a crude and impractical affair, and is only worthy of notice because it was the first of record. Many other inventors worked, liked Quincy, on this idea of a machine to pass over the row and pick the ears from the stalks. It would seem that a machine capable of gathering all the ears had never been made by any of them, although many have come near to attaining that result. Some machines have worked fairly well in corn that stood up in good condition, but this is not the real object to be gained. The successful machine, be it a field-picker or a harvester and binder, must work well under all conditions, whether the ears be three feet or seven feet from the ground, and whether the stalks stand upright or lie twisted and blown.

In recent years, since the development of the twine-binding harvester, practical men have been almost unanimous in the belief that the corn-har-

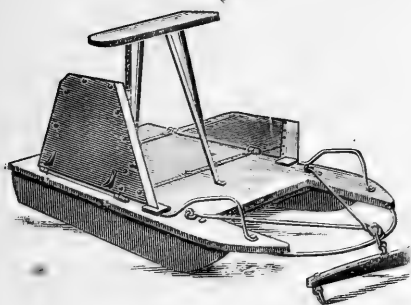
vester of the future will be a binder. In the meantime, however, another type of machine, dignified by the name of a harvester, has been perfected and large numbers made and sold. This is the "sled harvester," on which two men stand and gather the stalks in their arms as the machine is drawn forward, the stalks being cut by knives attached to each side of it at the desired height from the ground.

The first harvester of this class was patented by J. C. Peterson, of West Mansfield, O., who put one in the field in 1886. Soon after H. McDonald became interested, and removing to Bellefontaine, O., began manufacturing it the following year. Others followed and added improvements, until eight or ten harvesters of this type were in the field. Three were exhibited at the Columbian Exposition; by the Wm. N. Whitely Company, of Muncie, Ind., the A. W. Butt Implement Company and the Foos Manufacturing Company, both of Springfield, O. It is claimed that with one of these harvesters two men and a boy can cut 300 shocks per day. The men stand on the sled and each gathers an armful in passing from one shock to the next, taking two rows and stopping at each shock to deposit the corn at "gallus hills" previously prepared.

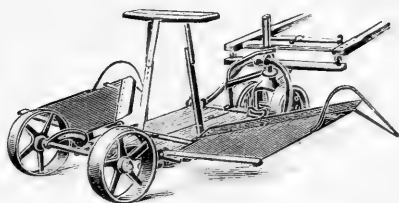
Nearly all the leading manufacturers of harvesting machines have experimented more or less with corn-harvesters, and three of them exhibited machines at the Columbian Exposition. D. M. Osborne & Co., of Auburn, N. Y., were the first of these three to come before the public, they having had in the field for three or four years a machine adapted to be used either as a corn-binder or an ensilage-harvester. As may be seen by reference to illustration, it has two gathering arms carrying endless chains, which pick up the corn and pass it backward to the table or elevator. The knife is of circular form. The binding attachment may be used the same as though harvesting wheat, or an elevator may be attached, as illustrated, having endless chains with fingers to carry the corn to the top and deposit it in a wagon driven alongside.

The McCormick Harvesting Machine Company, of Chicago, the pioneer reaper house, had on exhibition a machine that is odd in appearance, but gives promise of practical work. The horses are hitched behind this machine, the same as they would be hitched to a "header," an apparently advantageous plan. The down corn is picked up by gathering arms, which are provided with chains for passing the stalks backward to the cutting knife and the binder. A standard twine-binder is used, but set in a vertical position, so as to receive the stalks as they are cut and keep them vertical until the bundle is discharged. This machine is remarkably simple in construction, a feature that is generally more than half the battle in the development of an invention. The illustration shows quite clearly its general appearance.

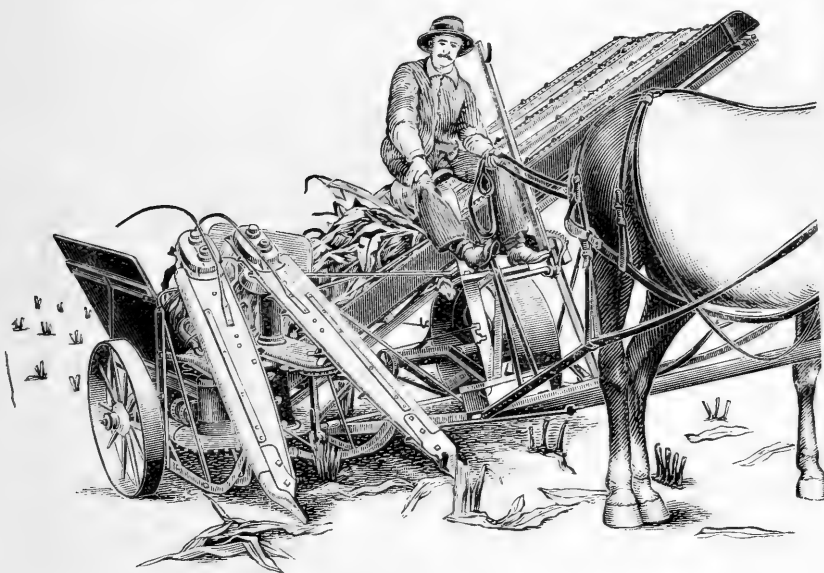
William Deering & Co., of Chicago, the pioneers in developing the Appleby twine-binder, have been experimenting since 1881 with corn harvesting machinery, and it is quite well known among machine men that they have expended in the neighborhood of \$200,000 in their search for practical inventions. Their exhibit at the Columbian Exposition probably attracted more attention from practical men than any other ma-



THE PETERSON CORN HARVESTER.



THE "SCIENTIFIC" CORN HARVESTER.



THE OSBORNE CORN HARVESTER.



THE McCORMICK CORN BINDER.



THE DEERING CORN HARVESTER AND BINDER.

chine exhibit, an indication of the interest that is felt in the problem of harvesting corn. Their leading machine is a modified form of the standard Appleby binder, the harvester being adapted to operate with the binder removed, to elevate the corn into a wagon. A circular knife or saw is used, set in horizontal position for cutting the stalks, which are bent forward by a hood, and fall upon a chain elevator which carries them over the drive-wheel to the binder, in the same manner as a canvas elevator carries wheat, but with the stalks in a reverse position, i. e., with the tops forward. The machine is simple in construction, and has made an excellent record in the field, especially in the examination conducted by the World's Fair judges. It rained during the trial, making the ground soft and the corn difficult to handle, some of it being thirteen feet high, and the wind blew a gale. The conditions could scarcely have been more trying, but the machine did excellent work. The illustration is from a photograph taken in the same field a few days after. Deering also exhibited at the fair a field-picking harvester, and a small hand-husker, operated by a crank, intended for use in the southwest where corn is stored in the husks to protect it from the weevil.

The development of the corn-harvester and binder by the manufacturers whose efforts have just been noticed, leads to the mention of a machine that can hardly be classed with harvesters, but which may be noticed in this chapter to better advantage than in any other of the chapters on corn machinery. The Keystone corn-husker and fodder-cutter, as made by the Keystone Manufacturing Company, of Sterling, Ill., has been before the trade for several years, and has become favorably known as a practical machine for the purpose indicated by its name. As the stalks are fed into the machine butts foremost, the stem of the ear is cut by the knives and the ear falls upon a series of inclined rollers under the feeder's table. The ear slides downward upon the rollers, which seize the husk and strip it away, allowing the ear to pass on and fall into a carrier, which elevates it into a wagon or bin. The operation is simplicity in itself, and the work done is quite satisfactory. A feature that appeals to the practical farmer, and especially to the stock raiser, is that the fodder is all saved and put into the most convenient form for feeding.

CHAPTER XIII.

Corn-shellers.

THE development of the corn-sheller has been contemporaneous with the pioneer work in corn-planters, cultivators and other implements. The one-row corn-drill or planter was used to a limited extent prior to 1850, and so also was the small hand corn-sheller. When the farmers found themselves in possession of improved planters and cultivators, with the effectiveness of labor correspondingly increased, they naturally began to inquire for a means of shelling the corn rapidly. Inventors were quick to answer, and practical manufacturers became interested in the new industry in due season.

William Cobbett, the noted English political writer, retreating from the difficulties into which his effusions had drawn him, came to the United States in 1817, and leased a farm on Long Island. He became much interested in corn-growing, and returning to England in 1820, he soon after took a farm there and began the cultivation of Indian corn specially, with a view of acclimating it. He says of shelling corn: "This is done in America by scraping or rasping the ears upon a piece of iron fixed across a tub, into which the grains fall. The iron is commonly a bayonet."

The Mexican Indians tie a bunch of cobs together in circular form, making what they call an *olotero*, and against this they rub off the kernels by hand. Many other crude ways for aiding the hands to shell corn by the turning, rubbing or grating process, were known and practiced in the early days before any one had thought of the first "one-hole" sheller, which was simply a hole smaller than an average ear, through which the cob was driven, leaving its corn on the way; and it was by improvement and a proper mechanical combination of these elementary methods that the first real corn-sheller was produced. The first efforts were directed towards shelling simply, the next to separating or removing the cobs, then the chaff and litter, and lastly to increasing capacity and perfection of operation. The balance-wheel, to give steadiness, was added quite early.

Knight, in his Mechanical Dictionary, gives very little indeed concerning shellers. He divides them into three classes as follows:

"1. The roughened or toothed disk which operates upon the ears in connection with a chute or oblique pressure-board, which holds the corn against the rubber.

2. The cylinder with toothed periphery acting upon the ears in connection with a concave which affords a gradually decreasing throat, as the ears roll and rub and part with their grains.

3. An orifice into which the ear is driven by a blow from a mallet, driving the cob through and shelling off the grains."

Probably the first description of a machine for shelling corn is contained in an English cyclopedia, dating back about sixty years. The following comment appears on this subject: "In this country [England] there are machines of different kinds which perform the operation of shelling corn with great rapidity; but whoever has a threshing machine might, by setting the rollers and drum somewhat wider than usual, dispense with manual labor, both in the operations of husking and shelling; and indeed we see no reason why the crop should not be harvested, like a crop of drilled beans, with Gladstone's bean-reaper, and sheaved, shocked, stacked and threshed like any other grain." Of the sheller illustrated the author says: "It is composed of a thin vertical wheel, covered with iron on one side made rough by punctures, which wheel works in a trough and separates the grains from the stalks [cobs] by rubbing. The ears or spikes of corn are thrown in by hand one at a time; and while the separated grains pass through a funnel below, the naked stalk is brought up at the end of the wheel opposite to that at which it was put in. The wheel may either be made rough on both sides or on one side, according to quantity of the work required to be done, and the force to be applied." Of another it is said: "Mariott's improved maize separator is the most perfect machine of this kind at present in use; it has not hitherto been much used in England, but a good many have been exported to America and the colonies."

Here we find that machines clearly belonging to Knight's first class—prototypes of the modern "picker-wheel" shellers—were built in England for the American market sixty years ago at least, and probably before any attempt had been made in this country to manufacture anything of the kind. This need not be wondered at, for the British were considerably in the advance of us, up to the last half century, in all these practical arts, both as inventors and manufacturers. It is since then that America has outstripped all other nations in the development, perfection and use of farm implements.

Hand-shellers of the "picker-wheel" type were probably the first that were made in this country. Of these the "Clinton" and "Burrall" were among the earliest to be produced for the market. In the *Prairie Farmer* of January, 1847, occurs the following:

"Mr. Bradley, of Kalamazoo county, Mich., asks: 'Will you not give us a pattern for corn-sheller—not of seven or one horse-power, but of one man-power—such as every small or large farmer may have without great expense, say from five to ten dollars?'" In reply the editor says: "Burrall's corn-sheller * * * is, as we are assured, an excellent machine, costing eleven or twelve dollars, made wholly of iron, and can be turned by hand or horse-power. It is to be had in eastern warehouses, but there are none of them or any other in our market." So, according to the *Prairie Farmer*, there were no corn-shellers for sale in Chicago nor elsewhere in the west, we would naturally assume; but Mr. Bradley's expression, "not of seven or one horse-power," indicates that he was acquainted with such as were run by power.

The late Augustus Adams, of Sandwich, Ill., the recognized leader in the development of corn-shellers, in answer to an inquiry some years before

his death, said: "The first sheller that I ever saw was one that 'Father Brewster' had when he came to Elgin, Ill., which he brought from the east, but where made I do not know. It was like one of our one-hole machines, except that it delivered the shelled corn and cobs all together. The first separating sheller I ever saw was the Burrall iron sheller, about 1843 or 1844, which discharged the corn at the bottom and the cobs at the end. This was built at Seneca Falls, N. Y. The first two-hole sheller that I know of was made by Allen Wayne, who furnished his own patterns and had his castings made by B. W. Raymond when the latter was in company with me at Elgin. Wayne failed, owing Raymond for castings, etc. Raymond took his patterns and stock and turned them over to us at Elgin, and we worked up the unfinished stock, which was the commencement of our making two-hole shellers. The first power sheller I ever saw was, I think, in 1843 or 1844, at Bloomington, Ill., and was what was known as the 'cannon' sheller. It was a cast-iron case about seven feet long and perhaps a foot in diameter, receiving the corn at one end and discharging the cobs at the other. * * * I do not recollect its internal arrangement well enough to describe it. I think it was made in Pennsylvania. The second was a cylinder sheller, made at Peoria. The next (about 1858) was the 'Magnolia,' built at Magnolia, Putnam county, Ill., which shelled with ribs on a cast cylinder, and it had, I think, a concave with round rods to let the corn through. * * * The next cylinder sheller that came considerably into use, more especially in warehouses, was the 'Richards,' made in Chicago. This had a revolving screen surrounding the cylinder to separate the corn from the cobs."

Thos. A. Galt, of Sterling, Ill., is another pioneer in the development of corn-shellers. At the time of the above quoted interview Mr. Galt had this to say: "My first experience with a power sheller was about fifty years ago, when a boy. We used to place the corn on a barn floor about a foot deep, and it was shelled out by horse-power; that is, by putting four horses on it and letting them tramp the corn off the cob, which at that time was thought to be a very successful way of shelling corn. It was probably before the time when such a thing as a corn-sheller was thought of. At that time, when corn was needed for domestic use, we usually placed eight or ten bushels of it in the large brick oven after the baking was done and dried it out; then it was removed into the kitchen to the big fire-place, and by laying a shovel over the tub we managed, as we thought, to shell very rapidly by hand. Some time after that we got a corn-sheller which, if I recollect rightly, was on the same principle as the present 'picker-wheel' sheller."

Mr. Galt said that he recalled "using a sheller at an early day made by driving broken nails into a cylinder, placing the cylinder in a box, and as the cylinder was turned it shelled the corn from the cob."

The Annual Register of Rural Affairs for 1857 says of Smith's patent "cannon" sheller, then manufactured at Kinderhook, N. Y., that it was considered the best then in use for shelling corn on a large scale, and described it as follows: "It is a horizontal-toothed cylinder, six feet long and fourteen inches in diameter. It can be operated by water, steam or horse-power, and hence would be very valuable in the western states, where Indian

corn is grown in large quantities. * * * The ears of corn are confined in the operation to a part of the upper or rising side of this cylinder by means of a cast-iron concave or case extending the whole length of the machine; and the corn being shoveled in at one end is driven through, and the cobs discharged at the other, while the corn falls below, being admitted by the small space on either side of the cylinder. The operation is governed by elevating or depressing the discharging end, which causes the machine to discharge the cobs fast or slow, and of course operating more or less upon them, thus securing to the operator the means of finishing his work. It is capable of shelling 200 bushels of ears per hour with a two-horse power. Price, \$45 and \$50." The Register also speaks of the "Clinton" one and two-hole shellers of the disk or picker-wheel type, as in general use. This sheller was built by the Clinton Agricultural Works, of Clintonville, Conn., and had a very extensive sale, in fact quantities of them were shipped abroad.

Mr. Adams moved from Elgin to Sandwich, Ill., in 1857, where A. Adams & Sons continued the business and put out several styles of shellers of the picker-wheel type; and before the war the firm had become widely known to the corn buyers on the roads running through the "corn-belt" on account of their two and four-hole horse-power machines. These were, as to shelling devices, simply enlargements of their hand-shellers, consisting of a large picker-faced disk or wheel, with a smaller wheel having beveled and ribbed face (stripping or feed wheel) faced to it, and a rag iron for each shelling set, and arranged in series of two and four for two or four-hole shellers. The four-hole machine was furnished with fan and elevator, and was turned by two horse-power. It was fed from a table on a level with the throats, a man on each side feeding two. Two expert men could put through about 800 bushels per day, a very satisfactory result, considering the inexpensive character of the machinery, the light force and power for operating it, and the neatness and cleanness of the work done.

Wm. Gillman, of Ottawa, Ill., early in the "sixties" began the manufacture of a cylinder sheller for portable service among the farmers. This was a very good machine and had considerable sale. It was the beginning of the business that for many years past has been conducted by the King & Hamilton Company. There was also in use before the war a cylinder sheller made at LaFayette, Ind. This was a large machine adapted to warehouse use, substantially the same as the one built by Mr. Richards, of Chicago, and known widely as the "Richards" sheller. Many others in the west began manufacture later, some of them continuing successfully to the present time.

In the east, besides the "Clinton," which received its name from David Clinton, who invented the bevel or feed-wheel and its combination with the picker-wheel, and the "Burrall," invented by T. J. Burrall, who about 1850 fixed his shelling device in a cast-iron case, with separator forming a part of the case, there were A. Blaker & Co., Newtown, Pa.; the Pennock Manufacturing Company, Kennett Square, Pa.; and Ruggles, Nourse & Mason, Worcester Mass., all manufacturing shellers along about 1850 of the picker-wheel type.

Who first in this country made provision for separating the cobs from the shelled corn in the "picker-wheel" class of shellers, it would be difficult to determine, but he only improved the principle applied to this purpose in the old English machine mentioned. At any rate the little "Burrall" had such a separating device, the cast shell in which the shelling wheels were inclosed being so arranged in relation to the large sheller-wheel (picker or straight runner) as to hold the cob, after the corn was shelled from it, pressed lightly to said large wheel in its revolution until the cob arrived at an opening in the case, through which it was discharged by its centrifugal momentum. Early in the "fifties" the slatted cob-rake, or riddle, on which the cobs were carried off—the corn sifting through—was introduced; and soon after came the fan for blowing out the light impurities. The late Augustus Adams, as early as 1854 or 1855, at Elgin, Ill., made two-hole hand shellers with cob-rakes. Slats of wood were arranged on a pair of leather belts, spread wide enough apart so that the slats, extending across from one end to the other of the belts, would about cover the width of the double set of shelling-wheels; the inner end of said carrier or cob-rake reached under the shelling-wheels, and the outer end—somewhat higher—projected behind so as to deliver the cobs free of the machine. The slats were so shaped as not to present flat surfaces for the shelled corn to ride on, but allowed the latter to pass freely through and down the delivery chute. About 1858 Mr. Adams produced a flexible iron cob-rake, which has proved to be one of the most valuable features of the modern Adams shellers. It was a rake made of iron or steel rods—three sixteenths to one-quarter-inch round, according to the size of the machine the rake was intended for—each rod forming a link, the ends being so peculiarly turned that, joining with those of the next link or rod, perfectly flexible connections were made. The rods formed the slats across, and enough thus connected made a thoroughly flexible iron riddle, as pliable practically for its purpose as cloth or leather, which, besides being durable, presented small, round surfaces upon which the kernels could not ride out and be wasted.

A two-hole one-horse power sheller, made by the Dillmans, of Plainfield, Ill., had a cob-carrier constructed and arranged like the first described as constructed by Mr. Adams, except that the slats consisted of folded strips of sheet metal. These presented a rounded face, but at intervals along the carrier the front lip or fold of a slat was left up to engage with lagging cobs and insure their passage up the incline to point of delivery outside. This feature was covered by a patent.

Cob-carriers and fans were usually at that time attachments to power shellers. Hand shellers, which were made by the parties above mentioned, by Galt & Tracy, at Sterling, Ill., and others in the west, were mostly of the Clinton or Burrall types, and generally without separating devices, or with such as were used to shoot out the cobs. After cob-carriers and fans had been added to picker-wheel shellers, the next step in development was the elevator, which device takes the shelled corn from under the machine and carries it up to be delivered into bags. This and other parts were improved and rendered more effective as the maturing experience of manufacturers saw the need.

The next and the greatest improvement for giving capacity to these shellers was the self-feeding device, invented by Augustus Adams about 1860. At that time one and two-hole shellers—hand and power—and those that had been made with four holes, were fed each from a table on a level with the feed throats by hand, the operator manipulating the ears so as to present them endways to the shelling devices. For the four-hole machine two men were required, one on each side of the table. The capacity of the power shellers fed thus depended largely upon the dexterity of the attendant feeders, and much loss resulted. The following is from the pen of Mr. Adams: "In the fall of 1859 I conceived the idea of carrying the ears to the throats of the machine by a series of belts, which proved a success, although it came near being a failure, as the belts would carry up the corn faster than the throats could receive it, causing clogging. To avoid this difficulty I conceived the idea of making and placing the picker-wheels in the throats as now used, which gave the desired result and made the feeder a success, enabling the operator to feed the machine by shoveling the corn into the feeder, and thus dispensing with hand feeding." This feeder for a four-hole sheller was constructed as follows: There was a long trough inclined backward from a point above the feeding throats of the machine, at an angle not too sharp to admit of the corn being carried up without much tumbling and rolling backward, and in this trough were arranged four carrying belts with lugs running parallel to each other, in parallel spaces corresponding to the four throats of the machine. The partitions that divided the trough into these spaces were so sloped or tapered that at their lower ends they scarcely rose above the level of the bottom of the trough, but they were gradually increased in their rise from the bottom as they approached the highest point, so the corn, shoveled promiscuously in at the lower end of the trough, was carried forward by the four belts, and as it progressed these rising partitions raised the ears that were lying crosswise above the lugs placed on the belts for the purpose of moving the corn upward, when, being thus released therefrom, their tendency was to roll backward off the edges of the partitions into the hollows between, lengthwise, and on the top of the lugged belts, which carried them in that position up to the highest point, whence they were discharged down corresponding chutes into the throats of the machines. Afterward, to prevent clogging at the throats, Mr. Adams placed a little picker-wheel at the side of each throat to aid in regularly distributing and in accelerating the ears as they passed into the shelling-wheels. These devices were improved in form and construction from time to time. They worked satisfactorily and gave much greater capacity to the shellers, besides providing a way for enlargement to six holes or more, but they did not yet constitute a perfect feeder, for ears would still wedge and clog at the feed throats. To remedy this defect and to make a positive feed the invention of H. A. Adams was added in 1872, which consisted in the location of a powerful shaft with wings or projections over the throats, so that in turning they seized upon the approaching ears, at the point where they were likely to hesitate and wedge, and forced them through. This device not only completely prevented clogging, but it also increased the shelling capacity largely. Another improvement in the construction of the feeder was made

some years after by J. Q. and O. R. Adams, sons of Augustus, but engaged in manufacture at Marseilles, Ill., who substituted chains for the former belts and rollers, thus obviating the difficulties experienced, when running in winter, with ice and snow.

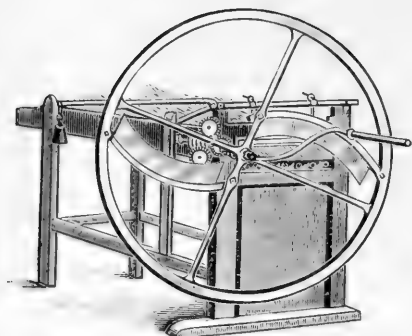
Other makers were active also. The Plainfield sheller had made an excellent record in improvements and practical operation. Meantime A. H. Shreffler had connected himself with the concern, and in 1867 the works were removed to Joliet, Ill., and there conducted under the title of the Joliet Manufacturing Company. Mr. Shreffler, in 1875 or 1876, made an important advance in the art by raising the main shaft of the sheller—the one upon which the "straight runner" or picker-disk is placed, and to which power is usually applied—to a higher plane than its companion-shaft, upon which the rapidly revolving "bevel-runners" or stripping-wheels, and the balance-wheel are placed, so that the ears of corn could be delivered closely to the throat of the machine and run into the shelling-wheels practically on a level; thus obviating the necessity of raising the corn so high as in the older form of feeder, and also, the difficulty consequent upon such raising—the tumbling and rolling of the ears in their descent. This improvement again added to the capacity as well as to convenience and quality of work, and was generally adopted by other makers. With these main improvements, and the many in details of construction which followed, the capacity of a four-hole two-horse sheller has been raised to 2,500 bushels per day when run to good advantage.

The Keystone Manufacturing Company, Sterling, Ill., successors to Galt & Tracy, made quite a departure from the ordinary picker-wheel sheller. They substituted for the bevel-runner or stripping-wheel and rag-iron with spring, a "shelling picker-shaft," with a shelling length of eight to ten inches. In this machine the shoe and screen have been discarded, and the separation is made by open links through which the corn passes while the cobs, etc., are being carried off.

CHAPTER XIV.

Feed and Ensilage-cutters.

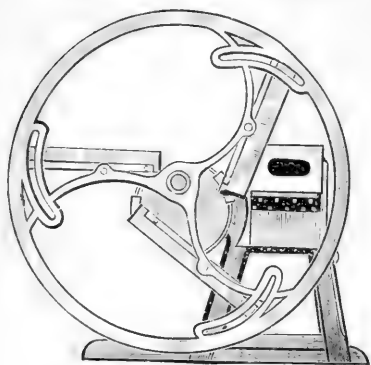
THE practice of preparing coarse food for cattle by cutting is probably as old as their domestication. Large vegetables would require reduction in size before they could be eaten, and the convenience of some preparation and regulation must have been soon recognized. The Hebrews chopped or cut both straw and grain in the bundle for feed, and so did the Egyptians, Greeks and Romans. The last-named people fed of various succulent grasses and vegetables, cutting up and measuring rations according to the requirements of their stock; but they probably had no machines for cutting other than knives or chopping implements. The first feed-cutter (for straw) mentioned in agricultural records, was invented by one Hochfield, in Saxony, over a hundred years ago, but no description appears in the brief notice of it. In Great Britain straw-cutters, mostly on the simple plan of a knife on a lever, pivoted at one end and having a handle at the other, were used. Vegetable slicers were also made and on the market during the latter part of last century, as were steamers, boilers, roasters, breakers and bruisers. Straw and chaff-cutters were patented in this country early in the century. Probably the first advance was the lever knife, the next a frame and feed box, with straight descending knife. These primitive cutters are designated as of the guillotine type, and to this class belonged the Hotchkiss straw-cutter, patented Aug 2, 1808, and again Jan. 17, 1817. There were several forms of these early guillotine cutters—that is, of those that operated on a straight line upon the straw or fodder as it was issued from the throat. By an early improvement the knife was given an endwise motion in addition to its descending, making a draw cut. Some had V-shaped knives or cutting plates, and others had double-edged knives—cutting on the return while ascending as well as when descending. Another class of feed-cutters had cutting knives upon a cylinder on a horizontal axis in front of the throat and cutting towards the axis. “Salmon, of Woburn, England [quoting from Knight], about seventy years since, introduced the oblique knife, attached cylinder fashion, between two wheels and cutting towards the throat of the straw box; revolving in the same plane of motion as the straw is moved. This feature is shown in the United States patents granted to Eastman, Jan. 29, 1822, and to Denson, May 2, 1835. Weir's chaff and fodder-cutter, used in England more than sixty years ago, was probably the first representative of another class. It had two curved knives attached, each with one end to a spoke and the other to the rim of a large balance-wheel. A crank was fixed to the wheel which, in revolving, carried the knives, the latter cutting against a plane at the end of the feeding trough or throat. This old English machine was of the class specified by Dr.



WEIR'S CHAFF PILER (OLD ENGLISH)



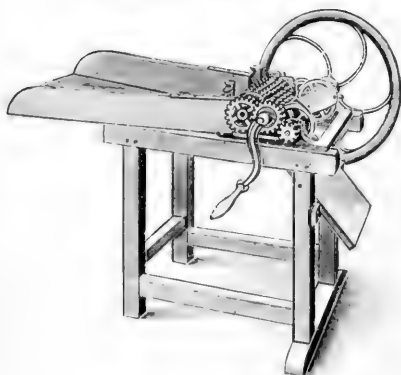
GUILLOTINE STRAW CUTTER.



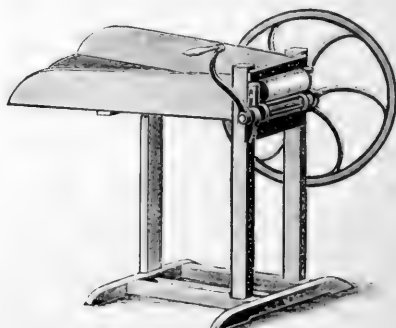
RADIAL KNIVES, DRAW CUT.



SMITH'S LEVER FEED CUTTER.



CYLINDRICAL STALK CUTTER.



HIDE ROLLER HAY CUTTER.

Knight as having "the radial or curved knife attached to a wheel revolving on an axis parallel to the direction of the feed and thus cutting off the straw as it issues from the throat of the machine." Albaret's (France) cutter belongs to this class, as do several styles of excellent cutters now made in this country. The knives of some of the machines of this class have a draw cut, being governed by eccentrics that give them a rocking motion. Spiral cutters of various forms were early invented. In one kind "one roller has spiral knives, and the other spiral abutment corrugations, whose intervals are entered by the knives." Some cylinder machines cut against rollers covered with raw-hide, and some cutters were self-sharpening. Circular saws, peculiarly arranged, were tried and used to some extent, and many other devices not mentioned, but these we have noticed represent various types of early cutters that more or less prefigured the perfected and enlarged machines now in general use. All these early feed-cutters were turned or worked by hand by means of a crank or lever, and at first they were fed by hand. The first attempt at automatic feeding was an endless web of cloth passing over two rollers. The next improvement was "a worm to turn two feeding-wheels to convey the fodder to the knives attached to two arms of the fly-wheel." This arrangement fed so that the fodder could be cut at such length as was required. Various improvements in self-feeding devices have been made since, affecting their facility and safety. These primitive machines were intended for cutting straw and hay chiefly; for corn-stalk cutting and rapid work more capacity was given in construction, and horse or steam-powers were attached.

It is scarcely fifty years since feed-cutters were first made for the market in the United States. In Great Britain, and on the continent of Europe to some extent, where farms are small, rents high and fodder dear, for perhaps a hundred years past machines of this class have been made and sold. They are not necessary tools like the plow—which all agricultural peoples, no matter what the state of their civilization, must have—but they are implements of economy, marking advanced intelligence on the part of the users. The peasant procured a plow of some sort, because he must have it or starve; it was not a matter to exercise his thought or judgment, it was one of necessity. On the contrary, the modern farmer or stock raiser buys a feed-cutter or grinder as the result of deliberate, intelligent consideration; and it marks his advanced capacity, while the failure to invest in such economic implements indicates lack of progress, and lack of ability to employ resources or materials to best advantage.

Some time early in the "forties" several parties in the eastern states began to make feed-cutters—then generally called straw or chaff-cutters—for a limited trade. That section of our country had become pretty well settled, and the rough, weak lands having been put largely to stock, economy in the use of feed began to be generally studied and practiced. The old firm of Ruggles, Nourse & Mason, at Worcester, Mass., made straw and hay-cutters previous to 1845; and in 1848 the New York State Agricultural Society awarded them first premium for their hide-roller cutter. A feed-cutter made by this old concern, having a pair of feed-rollers, was catalogued as early as 1847; and various forms and styles of these machines had

been produced and put upon the market by them early in the "fifties," affording types for many of the modern machines.

Bildad B. Belcher, of Chicopee Falls, Mass., was a pioneer in this line, and brought out the class of cutters known as "self-sharpeners." It seems that in the winter of 1849 an ingenious Vermont mechanic conceived the idea of a feed-cutter, the knives of which any person of ordinary intelligence might grind and keep in order, and produced what was known as the Yankee Blade. In the summer of 1852 Mr. Belcher became interested in it, and made arrangements for its manufacture and sale. He began operations in the fall of that year, improved the machine in various ways, and came out with it under the name of the self-sharpening feed-cutter. It sharpened itself by reversing the motion, and applying oil and emery. The working parts consisted of "an upper and lower cylinder, each provided with from three to nine flanges, according to the length designed to be cut. A straight stationary knife, made of the best material, and of great strength, is placed between the flanged cylinders, and arranged in such a way that the feed to be cut is caught by the flanges, passed between the cylinders, and is cut off as it is brought in contact with the knife. The flanges are made spiral, and make a smooth shear cut, cutting off the hay or other feed with the greatest ease and perfection. By this simple arrangement it will be seen a perfect self-feeding machine is produced, without the aid of a separate feeding apparatus."

Large numbers of these implements were made and sold, and they still hold a respectable place in the eastern markets. In 1850, or thereabouts, Warren Gale invented a cutter known since as Gale's, the knives cutting against metal instead of rawhide. This was a self-feeder, and was made by the firm of Belcher & Taylor, at Chicopee Falls, Mr. Taylor having come into the firm in 1861.

Feed-cutters, like corn-shellors, were made at first in a small way at many places, for the trade in vicinities, for any mechanic could make a practical hand-lever cutter; indeed, all that was wanted was a piece of scythe pivoted at one end and handled at the other, to be moved up and down before a V-shaped trough, in which the fodder is laid and fed by one hand, as with the scythe lever it is cut off by the other. Anybody, with the assistance of a country blacksmith, could make this sufficiently well to be thoroughly practical.

As far back as 1844, in central Pennsylvania, a machine consisting of a rotary disk having curved knives upon one side and a roughened grinding surface upon the other, revolving close to a stationary disk with a rough surface, was considerably used. It was without feed rolls, and the feeding of it was not only exceedingly dangerous, but very hard work, as the vibrations due to the knives striking the fodder were passed through the arms of the operator with such ill effect as to cause numbness.

As population moved westward grass and pasture lands became scarcer, or more were put under cultivation, and stock-raising increased largely because of the growing demand for beef and dairy products. It became essential to study the economies in feed and its preparation. Eastern farmers who moved west, and British and German farmers who immigrated

here, had been familiar with fodder-cutters for hay, straw or vegetables "at home;" hence when they became possessed of stock in numbers, they would naturally look out for feed-cutters, having known their advantages. So these machines were ordered westward—at first by those who had been familiar with their use, and then by others who became converted by observation, but the movement was slow. In the meantime factories in the west began making them, and since 1880 the discussion and adoption by many of the ensilage system increased largely the interest of farmers and stock-raisers. Intelligent feeders saw that a great saving in fodder could be made through proper preparation, careful experiments indicating a large percentage of gain over the old loose way.

Increased demand has, of course, resulted in active competition, and the latter has stimulated invention, so as trade in cutters has extended, various improvements have followed, especially in devices for adding to capacity and facility, but the markets are pretty evenly divided now between the two chief classes, and, as in other lines of machinery, what began in the east has culminated in the west, both in extent of trade and perfection of construction, and some eastern manufacturers have also followed "the march of empire" westward.

CHAPTER XV.

Grinding Mills.

NO one knows when ground grain was first fed to domestic animals. Sheep, swine, and animals for milk and meat were in domestication during the latter part of the stone age, when man began first to cultivate cereals, to grind and convert the same into primitive bread; and they would naturally eat the refuse with relish, which man observing would therefore give to them—the more thoroughly to subject as well as to provide for them. So the practice of giving to stock ground feed was coeval and has been current with grinding, since man began to do either; but it is not probable that any mill or grinder was made especially to prepare grain for such purpose before our own times. The stones of the old-fashioned grist-mills were set so as to crack wheat or oats or make coarse corn meal for feed, as farmers desired, and it is not probable that any portable mills for farm use were made until after metallic burrs had been invented and successfully used for grinding grain. At first, hand mills with iron plates were made to do coarse work where regular mills were not accessible, as in the army, to crack grain for slaves on plantations, and later, as enlarged and fitted for powers, to prepare food for stock. These were varied and improved to meet requirements and changes that time had rendered necessary, and finally they have come into general use as portable feed grinders. The demand for mills for such purpose stimulated invention, so various crunching, crushing, cracking and grinding mills with metal crushers or grinders have been produced, and burr stones also have been simply arranged and adapted in several forms to farm and plantation uses, of all which now there is a great variety.

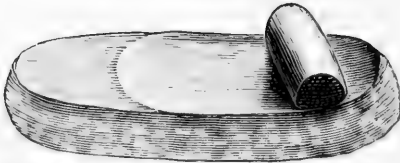
In the east, and wherever grist mills were common and convenient, farmers and feeders of stock could get their grain prepared without difficulty; so there they have longer been disposed to use ground feed, and more generally than in the west, or in other places where water-power was scarce and mills few; but the advent of cheap portable grinders, coupled with improved systems of stock-farming, reversed these conditions. In the west where grain, especially corn, was cheap, or where methods were primitive on account of remote location, ear-corn was, and to some extent is yet, dumped upon the ground—in the mud which the weather so frequently provides—for the stock to eat, as well as they might, what of it was not necessarily wasted. This was the rule all over the settled portions of the west thirty-five years ago. During the Crimean war, which began in 1853 and ended in 1856, prices for grain advanced considerably, and a bushel of corn was of so much value that the farmer disliked to feed it out, especially to throw it upon the ground, where a considerable portion must be wasted.

Economy in feed, unthought of before, became a subject for study. He measured and scrimped where before he had thrown out hap-hazard, and he fed to avoid useless waste. He soaked the grain; he carefully saved the tailings; he bought bran; he invested in patent steamers for cooking vegetables and other fodder, mixed; in fact he did what he could to fill and fatten his stock with something cheaper than grain.

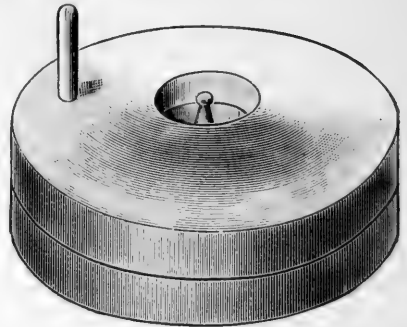
It was not then a question of proper feeding so much as of cheap filling, that engrossed the farmer's mind. About this time the cob and corn-mill man came around and he was made welcome; and the shrill shrieks of metallic disk grinders were borne upon the breezes. But this war closed the crash of 1857 followed; in 1858 continuous rains destroyed the crops; in 1859 frost killed the corn generally; in 1860 there were splendid crops, but prices were so low in the winter of 1860-61 that corn was quite commonly burned as ordinary fuel. During these years the feed-grinder man disappeared. In 1861 grain began to feel the effects of the civil war; prices went up and up year after year, and again the feed-grinder man appeared, this time, however, to stay, for he brought around better mills, and the farmer had begun to study methods of feeding for the purpose of improving the size and quality of his stock as well as economizing food. Progress was slow at first after this reaction, for grinders were still imperfect; but as the advantages of ground feed over grain in the natural state became apparent, the demand increased, and this of course stimulated inventors and manufacturers to improve and perfect their various devices, and so the trade has increased.

The first known use of metallic disks or grinding plates was by the French during the time of Napoleon I and in the army. The mill adopted by this great general to provide meal for his soldiers "while on the road to Moscow" is described as follows: "It consisted of two circular cast-iron plates, about twelve inches in diameter, placed in a vertical position. One was fixed, the other rotated by a hand-crank. The plates were indented all over with radiating grooves, and the corn [grain] was conducted to the center, or eye, by a lateral hopper. The meal, as it was ground, was projected from the periphery by the centrifugal force of the revolving plate." Another mill, of French invention also, stands on a tripod or three legs. It has two hand-cranks, each for a man, to drive the grinders—the meal being delivered in a sack suspended beneath and between the legs. Francis Devereux, in France, obtained a patent for a military mill in 1824; but it seems to be substantially the same as those used a dozen years before in the Russian campaign, already described, except that the grooves cut in the metallic plates radiated regularly from their centers. From these or like originals the disk grinders have emanated.

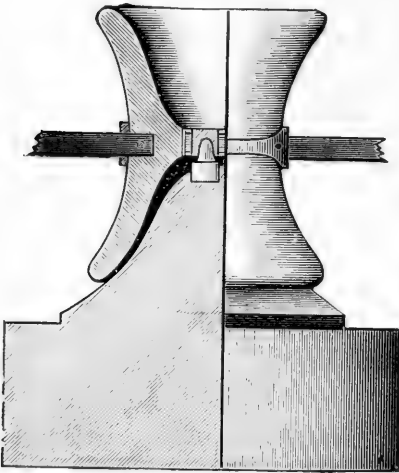
Feed grinding mills, with metallic grinders or burrs of the conoidal or conical form, with correspondent shell or "bell" turning on a vertical axis, on the principle of old-fashioned pepper mills, were prefigured in form to some extent by mills found at Pompeii, as also by some of the ancient querns. Hand mills on this principle were made and used by soldiers, pioneers and others requiring them for grinding grain, but not to the same extent as those of the other class.



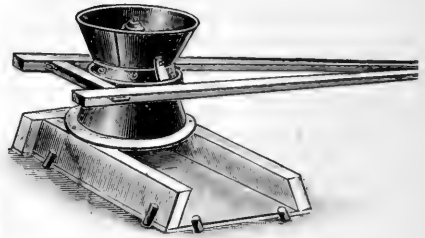
EARLIEST FORM OF GRAIN MILL, STONE AGE.



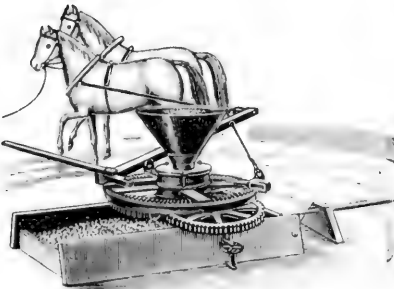
ANCIENT QUEEN MILL.



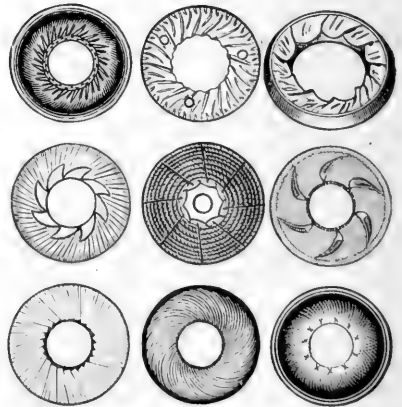
ROMAN MILL FOUND AT POMPEI.



THE "LITTLE GIANT" FEED GRINDER.



THE BUCKEYE MILL.



VARIOUS STYLES OF DISK DRESS.

Mr. Marsh says that his first experience with a feed-grinder was at the close of the Crimean war, but before the reaction had fairly set in. Grain was still high and economy in feed was an important consideration. The mill he then used was known as the "Little Giant." It was built at Cincinnati, O., and was the production of J. A. Hedges, who gave it the name by which Senator Stephen A. Douglas was familiarly known in the west. It was a sweep mill, low speed, not unlike in appearance others of the class as made now, and was intended only for crushing and coarsely grinding cob and corn for stock. The ears were thrown into the hopper, spike teeth directly under in revolution seized and crushed them, and then they were ground between the lower portion of the conoidal burr and its correspondent shell—the meal falling into a box below. In direct evolution the "Big Giant" came next, with blades for crushing, and ribs decreasing in size and increasing in number toward base of the cone and shell—the dress resembling that of a burr stone.

C. Leavitt, in 1855, patented a mill of this class which was built at Mansfield, Ohio. Mr. Leavitt died several years ago, but his feed-grinder, with various improvements, is still built by several manufacturers.

Freeport, Ill., is noted for the invention and manufacture of feed-mills of this class. Several years ago the Morgan Bros. began making them, and to obtain greater capacity they invented the triple gear, whereby the cone was made to revolve three times as fast as the shell, a combination that became very popular. The Stover Manufacturing Company then commenced to make a sweep grinder of similar style, Stover's patent. At about this time George K. Smith invented a combined horse-power and feed-mill, which he, in connection with H. C. Staver, of Chicago, introduced under the name of the "Buckeye." Mr. Smith afterward invented a new combined power and mill which he called the "Victor."

CHAPTER XVI.

Wind-mills.

THE use of wind, like the use of water, for power purposes, was first suggested by the observation of its natural force and capacity to move objects, and its tendency to turn or whirl them around under certain conditions. Probably the original wind-mill was made by primitive man as a toy for his child, and the first water-wheel may have had its origin in the same way; then as form and action were improved by frequent construction, their utility for the conveyance of power became apparent, and simple experiments for such purposes were made. We can only imagine how the forces of wind and water may have been originally used to give motion to wheels, but when or for what practical purpose first applied even imagination fails to give us any conception. Wind and water, the moving forces of nature with which man was in common contact, gave him the first ideas of mechanical power. Probably water was put in service before wind, but the use of both elements for power began far beyond the reach of the records or traditions to which we now have access; and when we come down to historic times we find much uncertainty and some contradiction among old as well as modern writers on the subject.

Wind-mills for grinding grain, according to various accounts, were used in the east long before the Christian era, but the earliest recorded application of wind power was for another purpose. A description is given in the "Spiritalia," by Hero of Alexandria, B. C. 150, of a wind-mill which worked the piston of an air-pump to blow an organ.

The world was set back many centuries, and arts were lost that may never again be found, when the Alexandrian library and museum were destroyed by the fanatics of the times; but fragmental descriptions of what was there have come down to us, and show that the genius of invention had traversed every line in the remote past and long before our era, in which latter there has been chiefly a great revival of old devices and an adaptation of them to practical uses far beyond that of any previous age.

Johann Beckmann, a German professor of natural sciences, in his "History of Inventions," written 1780-1805, and translated into English in 1817, discusses wind-mills largely and learnedly. He says: "Mabillon mentions a diploma of the year 1105, in which a convent in France is allowed to erect water and wind-mills *molendina ad ventum*. In the year 1143 there was in Northamptonshire an abbey situated in a wood, which in the course of 180 years was entirely destroyed. One cause of the destruction was said to be, that in the whole neighborhood there was no house, wind or water-mill built, for which the timber was not taken from this wood.

"In the twelfth century, when these mills began to be more common, a dispute arose whether the tithes of them belonged to the clergy, and Pope Celestine III determined the question in favor of the church. In the year 1332 one Bartolommeo Verde proposed to the Venetians to build a wind-mill. When his plan had been examined a piece of ground was assigned to him, which he was to retain in case his undertaking should succeed within a time specified. In the year 1393 the city of Spire caused a wind-mill to be erected, and sent to the Netherlands for a person acquainted with the method of grinding by it. A wind-mill was also constructed at Frankfort, in 1442, but I do not know whether there had not been some there before."

Wind-mills seem to have been common throughout the more civilized portions of Europe during the middle ages. Besides in Germany and Holland, they were mentioned as used at a very early time in Bohemia, in France, and later in England, Italy and Spain. The Spanish author, Cervantes, who wrote "Don Quixote" about A. D. 1600, in relating the adventures of his crazy knight, tells of his encounter with one of thirty or forty wind-mills that stood in a plain through which he traveled.

An incident relating to the erection of a wind-mill in the Netherlands, which shows the condition of the times, and the assumption and rapacity of the ruling classes, is quaintly told by the chronicler, Jargow, and is mentioned in Wolff's "The Wind-mill as a Prime Mover." "As our monastery had not a mill to grind corn, they resolved to build one. When the Lord of Woerst heard this he did everything in his power to prevent it, saying that the wind in Zealand belonged to him, and that no one ought to build a mill there without his consent. The matter was therefore referred to the Bishop of Utrecht, who, as soon as the affair was made known to him, replied in a violent passion that no one had power over the wind within his diocese but himself and the church at Utrecht; and he immediately granted full power, by letters patent, dated 1391, to the convent at Windsheim to build for themselves and their successors a good wind-mill in any place which they might find convenient." In like manner the city of Haarlem obtained leave from Albert Count Palatine of the Rhine to build a wind-mill in the year 1394.

Wind power for drainage or drawing water off land was used in Holland several hundred years ago. There is an account of a mill of that kind which was built at Alkmaar in 1408; of another at Schoonhoven in 1450; of still another in Enkhuysen in 1452, and undoubtedly many others were built for such purpose about that time.

The earliest wind-mills were stationary, and were therefore set for the prevailing wind, because they could receive it from one direction; and later, some were placed on floats upon the water, so that they could be easily moved around to catch the wind from whatever quarter it might blow; next "post" mills were erected, in which the whole building, with the wind sails, shaft and the machinery is supported upon a vertical post or column upon which it revolved when actuated by a lever, but not automatically. Later on, "tower" mills were constructed, in which only the head, cap, or dome of the building, with the shaft which it contained, revolved. These, after automatic regulators for turning them to the wind had been applied, became the standard European wind-mill. Quoting

from Wolf's work: "European wind-mills have been divided into two general classes, according to the inclination of the shaft:

"1. Horizontal mills, in which the sails were so placed as to turn, by the impulse of the wind, in a horizontal plane, and hence about an axis exactly vertical; and

"2. Vertical mills, in which the sails turn in a nearly vertical plane, *i.e.*, about an axis nearly horizontal."

In "vertical" mills of the European type the tower or building which supported the wind-mill proper was either of wood or stone; if of stone, the tower was commonly in the form of a frustum of a cone. The principal parts of the mill proper are:

"1. An axle or shaft, either of wood or stone, in the top of the building, inclined to the horizontal at an angle of from ten to fifteen degrees, as observation has shown that the impulse of the wind is usually exerted in lines descending at such angles.

"2. The sails attached to near the outer extremity of the shaft, and turning in nearly a vertical plane. The planes of these sails are placed obliquely to the plane of revolution, so that when the wind blows in the direction of the axle it impinges upon their surface obliquely, and thus the effort of the sail to recede from the wind causes it to turn upon its axle. These sails consist of wooden frames (arms and cross-bars), with canvas covering the lattice or frame-work. If four in number, as is the rule, though five and six have been employed, the sails are fixed in position at right angles to each other. They are usually constructed from thirty to forty feet in length, though fifty feet has often been exceeded.

"3. A large-toothed wheel upon the horizontal axle, the teeth of which engage with those of a pinion upon

"4. A vertical shaft from which motion is imparted to the machinery.

"It will be understood that the horizontal shaft is supported at its inner end near the center of the base of the dome or cone surmounting the mill, while its opposite extremity passes through a perforation in one side of the dome, where it has its main support, and projects far enough to receive the ends of the long timbers or arms of the sail. The pivot at the lower or inner end of the shaft takes up but a small part of the weight and counter-pressure.

"The axle is constructed of some hard wood like oak, or of wrought-iron, with cast-iron flanges of large diameter keyed on the front, which are furnished with recesses for receiving and holding the arms of the sails.

"The sails are made plane, concave, or warped. The latter, the most effective, have been in greatest use; and the angles employed in the Dutch type of mill ('tower') have, on the whole, approached very closely to those which theoretical analysis proves to be the most serviceable. Where plane sails have been used the bars have all had the same angle of inclination, ranging between twelve and eighteen degrees to the plane of revolution."

The "post," also called German mill, as mentioned before, is supported upon a massive central column, around which the superstructure is revolved to meet the wind. This type is not used to any extent now, if at all, and need not be described. In the "tower," known as the Dutch mill, the dome

only is turned with the axle and sails. The vertical toothed wheel travels around the pinion of the post, so the connection is not broken. "The turning of the dome was formerly effected by a toothed wheel, which engaged in a rack on the inner side, and which was turned by an endless cord pulled by a man; but at the present time Cubett's method is employed. This consists of a set of small sails, or an auxiliary wind-mill placed in an upright position upon a long arm or frame projecting in the plane of the horizontal shaft, but on the opposite side of the dome, the plane of the sails of the auxiliary wind-mill being nearly at right angles to the plane of the sails of the wind-mill proper. By their revolution the sails turn a shaft and pinion, and finally act upon teeth surrounding the exterior of the dome, turning it until the wind no longer moves the auxiliary wind-mill vanes, when the sails proper will be exactly in their best position to receive the impulse of the wind." It must not be supposed that this is the only method of automatically turning the sails or face of a wind-mill to position for best receiving the wind, for in "The Complete Dictionary of Arts and Sciences," published in 1766, may be found a cut and description of a wind-mill quite like those in common use in America, with a vane for turning the face of the wheel—consisting of eight sails or sections on as many arms—to the wind; and wind-mills of various types other than those just mentioned were long ago and are now used in Europe, and for different purposes; but those we have described represent the standard European mills, such as have been—as primitively constructed and as improved—in common use there for hundreds of years.

The variations in the intensity of the wind made it necessary that some method of governing or regulating the mill be provided. This was accomplished by changing the extent of sail surface offered to the wind; that is, by furling or unfurling the sails. At first much trouble and delay were occasioned by this method of regulation, as the mill had to be stopped while it was done; so inventors sought better plans. In 1870 Andrew Meikle, the same Scotchman who a few years after invented the first successful threshing machine, devised for reefing wind-mill sails when in motion "an ingenious application of the centrifugal governor," viz.: a sliding piece, which operated upon rollers placed transversely with the arms, and wound up or reefed the canvas when the sails attained too great a velocity. The unfurling of the sails or increasing their speed was accomplished by a weight which actuated a rod passing through the center of the main axle, and operated centripetally on the sliding frames; and then unwound the canvas when the motion of the sails was too much retarded." This was the first successful reefing apparatus for wind-mill sails, and it imparted a steadiness of motion never before attained, and not since excelled to any extent. Various other methods for governing wind-mills of the European type have been devised and successfully applied, and many improvements have been made. The use of wind power is as old in Europe as civilization. It has been applied chiefly to grinding grain, and next to pumping. In the low lands, as in Holland, one sees wind-mills everywhere. Long lines of them pump the waters off the sunken lands, and others grind grain or furnish cheap power for various mechanical and manufacturing purposes. Many



DUTCH OR "TOWER" WIND-MILL.



GERMAN OR "POST" WIND-MILL. A. D. 1200.



THE HALLADAY STANDARD WIND-MILL.

wind-mills of the European type have been erected in the United States, and in German or Dutch settlements we find them often.

With wind-mills, as with other classes of machines and implements, while we may find traces of them in the remote past, and considerable development in Europe, yet in the United States only have they been brought out in such practical forms and perfection of operation as to come into common use for various purposes. Wind, though furnishing abundant force as a motive power, is uncertain and irregular in the extreme, hence it has taxed the ingenuity of man, far more than water has, to provide means by which this unstable and violent power could be subjected to his will; and the success that he has attained, the delicacy and perfection of action with which his devices adapt themselves to the varying moods of so fitful a fluid, are indeed wonderful.

The purposes for which wind power may be used are many and increasing, and the manufacture of wind-mills has become one of the important industries of the United States, employing the very best inventive talent and mechanical skill, and occupying now the large number of factories engaged in the business for their full capacity. Many thousands of wind-mills or wind-engines are annually manufactured, for a trade not limited to particular sections, but as broad as our country, in fact, reaching far beyond, for the foreign demand takes a considerable portion of this annual product. Where moderate force is required, but not a continuous or too rapid motion, wind-power is sufficiently reliable to be thoroughly satisfactory, and it is the most economical.

The main difference between American and European wind-mills is in the form of the wheel upon which the force of the wind is received, and by which motion is communicated to the machinery or operating parts attached. Instead of a small number—usually four—of very wide sails common to the foreign mills described, the American wind-mill consists of a large number of narrow and comparatively short slats or blades so set with reference to the common center as to form a wheel in general appearance. By this plan sufficient wind surface is provided, and size, capacity and strength are obtained with a minimum of weight, as well as symmetry and convenience of construction. American wind-mills are of the vertical class, chiefly, although horizontal mills have been used to some extent.

The wind-mills now used in the United States may be divided into two general classes:

First, in which the wheel is composed of sections, is flexible or folding, and is commonly known as "open" or "sectional," with or without vane to bring wheel around to the wind. Regulation is accomplished by devices which project toward the wind the inner ends of the fans or sections of the wheel.

Second, where the wheel is "solid," that is, the sections or fans of the wheel are secured firmly to the arms and do not fold as in the open wheel, with vane so placed and arranged as to regulate and govern the mill.

There are many types which scarcely belong to either class, but are departures from one or the other.

Wind-power is now largely used for the following purposes: For water-

ing stock on dairy or stock farms; for domestic and ornamental uses; for water supply and for protection in towns and villages; for pumping water at railroad stations; for irrigation and drainage; small-gearred wind-mills are used for grinding feed and running light machinery on dairy and stock farms, and large-gearred for running custom flouring mills, and shafting and machinery of various kinds. It does not follow in any of these applications of wind-power that a suspension of work during a calm materially injures its usefulness, hence it is peculiarly adaptable to them. But it can be applied to work where accumulated power can be stored for future use, besides the storage of water; for instance, for compressing and storing air, and for driving dynamo machines to charge electrical accumulators. Mr. Wolff, in his "Wind-mill as a Prime Mover," says regarding the latter proposition: "This was first suggested in 1881 by Sir William Thomson. The application of the wind-mill to this purpose will soon come actively into play when storage batteries have been developed to a greater success than is attained at the present time." Wind-mills have made many sections inhabitable, and enjoyable also, where streams and springs are lacking. They provide fresh, pure water for stock, and for domestic as well as ornamental purposes. They have been the means of rapidly increasing the dairy interests of this country by furnishing supplies of the limpid liquid, making it possible for every farmer to have a "living spring" at his door and under his control. The health of animals depends upon having pure water to drink, hence wind-mills aid and regulate the sanitary conditions of the household, and of the barn and farm yard largely. No power can more economically store water in towns and villages for fire protection, and domestic uses; in fact no power is so generally desirable and satisfactory, counting cost and results, where the conditions are such that it can be successfully applied.

The Halladay "standard" wind-mill is generally recognized as the pioneer in the first class. It was the invention of Daniel Halladay and John Burnham, and the story of its birth is as follows:

"Going to Ellington, Conn., Mr. Burnham engaged there with Henry McCray in the pump business, and soon began the sale of the now well-known 'hydraulic rams.' He continued in this business until he was nearly thirty years of age, and during that time found so many who wanted running water where they had not fall enough to use the ram, that his attention was directed to wind as a motive power. Here was the power of millions of horses sweeping through the heavens over every man's farm throughout the known world, that might be utilized to the saving of human—the dearest of all—labor. It was this thought that inspired him and urged him on to the prosecution of that invention which has more than met his hopeful expectations. There was at that time no factory making self-regulating wind-mills in this country, and probably none in the world; and this was the reason Mr. Burnham divined why there was such great difficulty in producing a machine that could stand the strong winds, and he felt that if this difficulty could be obviated the success of such a machine would be certain. Feeling that he had but limited abilities as an inventor, he applied to Daniel Halladay, then conducting a small machine shop in the

village, and after several times calling his attention to the subject, secured from him the reply: 'I can invent a self-regulating wind-mill that will be safe from all danger of destruction in violent wind storms, but after I should get it made I don't know a single man in the world who would want one.' Being assured by Mr. Burnham that he would find men who wanted them, he began and soon produced a self-regulating wind-mill. The two now united in the enterprise, and in the summer of 1854 organized a joint stock company in South Coventry, Conn., with Mr. Halladay as superintendent and Mr. Burnham as general agent. The wonderful growth of the enterprise is abundantly shown in the fact that when the machine was first entered at the state fair for a premium it had to be entered as a miscellaneous article, as no such thing had ever been entered on a fair ground for a premium, while to-day there are dozens at every state and county fair throughout the country, and millions of dollars are invested in their manufacture."

There is probably no important invention in the history of the agricultural implement industry that has more romance in the circumstances connected with its conception than the "solid wheel" wind-mill. Its inventor was a missionary named Wheeler who had settled in northern Wisconsin in 1841 and was laboring patiently to Christianize the Indians and to teach them the habits of civilized life. It is said that the idea of a wind-mill to grind corn and wheat and pump water for the Indians occurred to him in 1844, but it was not until 1866 that he took steps to put his idea into practice. He had fallen from a ladder at this time and broken his wrist, and to keep his mind engaged while the fracture was healing he drafted with his uninjured hand the plan of his invention, using a jack-knife and a board laid across his chair. The same day that his wrist was broken, his son, who had started on a journey to St. Paul, 200 miles away, was brought back with a broken leg caused by a falling tree. The father had a good pair of legs and the son a pair of sound hands, and as soon as they were able they made the wood parts of their wind-mill. The government blacksmith nearby became interested in the project, and made the necessary mountings. April 26, 1866, the new invention was put in operation and worked successfully at first, but a storm soon after tore it to pieces. This led to a deeper study of the problem, and Wheeler then conceived the idea of a "side vane" set against the wind, with the wheel pivoted so a strong wind would blow it around at an angle or entirely out of the wind. In two months a mill of the self-regulating type was in operation. The inventor, however, was failing fast in health, and that fall he moved to Beloit, Wis., surrendering his missionary work. In the spring of 1867 a wealthy banker from the east, a relative, visited them, and he recognized what had never occurred to Wheeler, the value of a patent on the invention. At his solicitation Wheeler began on a model, but his strength only permitted him to work a few minutes at a time, and it was not finished for two months. It was then sent on to Washington, however, and a patent was granted in due time. Manufacturing was begun soon after at Beloit, laying the foundation for the business of the Eclipse Wind Engine Company.

The revolution in the wind-mill industry which has resulted from the

introduction of the steel back-gearred mill (the Aermotor) is noticed in detail in the historical sketch of the Aermotor Company of Chicago. The change consisted in substituting a lesser number of wide steel slats, curved in cross section, in place of the thick wooden slats common to the old style mills. This change has eliminated the obstruction to the wind that was inevitable in the old form of construction, and has greatly increased the efficiency of a wheel of the same size. A steel wind-mill is thus able to run in light winds that would bring no response from the heavy wooden wheels, and its usefulness on the farm is correspondingly increased. In fact, the change has opened up new possibilities in the use of power mills for feed-grinding, wood-sawing and the performance of other work in which light power is required. The durability of the new form of mill has been insured by a process of galvanizing each section after it has been assembled. Every part of the mill thus receives the protective coating. The same galvanizing process is applied to the steel towers.

The revolution resulting from the introduction of steel has not yet gone far enough to demonstrate fully what may be done in irrigation, but the experiments of recent years would indicate that this field is full of possibilities. The cumbrous Dutch mills have played an important part in the history of Holland, in reclaiming from the ocean and keeping clear of water a large part of the land under cultivation in that country, and it may be that the sprightly steel mill of the western continent will perform an equally important task in watering the arid regions west of the Mississippi and Missouri rivers.

CHAPTER XVII.

Miscellaneous Agricultural Implements

THERE were exhibited at the Columbian Exposition many interesting and useful implements whose manufacture has not assumed the importance of the classes that have been noticed in the preceding chapters. It would be impossible in the scope of this work to give historical information regarding any of these implements, and the best that can be promised for them is a brief review of the points of excellence in a few of the most important of them.

THE BEMIS TRANSPLANTER.

The Bemis Transplanter was exhibited by the Fuller & Johnson Manufacturing Co., of Madison, Wisconsin. It is designed for setting out tobacco, tomatoes, strawberries and other plants that are transplanted from a hot bed to the open field. The dropping is done by hand by two men or boys, who ride on the low seats in the rear. The planter opens a furrow and drops a quantity of water for each hill, and the droppers place each plant in the water and allow the packing plates to cover and press the dirt around it. The row is thus left in a ridge, about one inch higher than the level of the field. A check-rower is provided when desired, to drop the water in the same manner as corn is dropped, and the plant is then set just as the water falls. Many advantages are claimed for setting the plants by this machine, besides the saving of labor.

THE ASPINWALL POTATO PLANTER.

The transplanter naturally suggests an implement that was not on exhibition, but has become quite well known during the past few years, the Aspinwall potato planter. This implement successfully performs a task that is one of the most tedious on the farm, when done by hand, and its work is quite satisfactory. The furrow is opened by a peculiarly shaped plow, and the cuttings or seeds are dropped and covered automatically. The dropping device is the most interesting feature of the machine. It consists of several bars or spokes hung to the middle of the revolving axle of the planter, each having a peculiar hook or claw at its outer end. The potatoes, which are carried in the large hopper shown, are allowed to pass down through a gate upon a concave, and each revolving hook or foot passes upwards among them in its revolution, and grasps a cutting which it carries and drops at the proper time. The operation is quite simple, but a difficult one to describe. The dropping mechanism can be adjusted to plant at any distance desired. Five to eight acres per day can be planted, the work being accurately done and superior to hand work. A great advantage is claimed for covering the seed with fresh, moist

earth, rather than with dry soil, as is often the case when planting is done by hand.

POTATO DIGGERS.

The Hoover potato digger was one of the few implements exhibited in this line at the World's Fair, and was the only one that has become generally known both in this country and abroad. It has a strong scoop-like plow which passes under the hills and throws them upward upon a chain carrier. This carrier passes the earth and potatoes backward and upward, taking the dirt through and leaving the potatoes on top of the ground.

THE KEMP MANURE SPREADER.

The saving of manure and putting it upon the land has been in the past a disagreeable feature of farm work, although every farmer understands the value, and in many parts of the country the necessity, of returning to the soil as much as possible of the vital elements that have been taken from it. Kemp's manure spreader is intended to simplify this work, and at the same time to do it more efficiently. A revolving toothed cylinder is mounted in the rear end of a wide, specially constructed wagon box, and in its operation throws the manure out in a thin, even layer, covering every part of the ground traversed. The wagon box has a movable bottom, consisting of slats connected with each other by a link belt, and moving over numerous small rollers, so as to feed the load to the cylinder.

IMPLEMENTS FOR SUGAR BEET CULTURE.

Our manufacturers are giving considerable attention to the production of implements needed in sugar beet culture, and at least three of them had exhibits at the Columbian Exhibition. The Johnston Harvester Co., of Batavia, N. Y., exhibited among other implements a beet cultivator and also a harvester. The peculiar feature of their cultivator is found in the spiders used in place of shovels. With them it is possible to cultivate much nearer to the growing crop, without covering up the plants, especially when they are very small, than would be practicable with a shovel cultivator. The spiders do not drag through the ground. Each spider finger is forced into the soil to a depth of three or four inches, and when withdrawn brings up the weeds without interfering with the roots of the crop. It may be set to cultivate any crop two rows at a time, provided the rows are not less than sixteen and not more than twenty-four inches apart. Knives are provided to be used in place of these spiders whenever they may be found preferable.

The Johnston beet harvester is designed for digging and topping sugar beets at one operation. The shares penetrate the soil from four to six inches on either side, and loosen the beet without wounding it or breaking the tap root, the top being meantime cut off and carried out of the way by an ingenious device.

The Moline Plow Company have a beet harvester quite different in the frame that carries it and in the topping device, but the same principle is used in the digging share.

PART II.

PIONEER MANUFACTURING CENTERS.

Chicago.

WILLIAM DEERING & CO. AND THE TWINE BINDING HARVESTER.

CHICAGO may well be proud of the beautiful Columbian "White City," the magnificent four-century plant that has opened its petals on the shores of Lake Michigan before the admiring people of all nations. The most marvelous enterprise ever conceived for man's entertainment and education, it has come as the crowning event in a development that stands without parallel in man's history, the building of one of the world's great cities and the settlement of an agricultural empire, within the memory of those now living, almost, we might say, within a generation. In this brief period perhaps the greatest migration in the history of the human race has taken place, with Chicago as its focus, resulting in the settlement of the vast agricultural area of the Mississippi valley.

Two factors have contributed to this rapid development: First, the railroads built in response to the demand of pioneer settlers, or to invite settlement and cultivation; and second, the improved agricultural implements, by the use of which the settlers were able to pay for homes and to furnish traffic in farm products that would sustain the railroads. Which factor was the more important it would be difficult to determine, but it is certain that not one-half of the roads now in operation in the Mississippi valley would have been built without the prospect of the traffic that would come from improved agricultural methods. It is even safe to say that without the twine-binding harvester our statistics of small grain production would tell an entirely different story, and the western half of the country, with its millions of fertile acres that now bear abundant harvests and support a thrifty farming people and prosperous cities, would not have made one-half the progress with which it has been blessed.

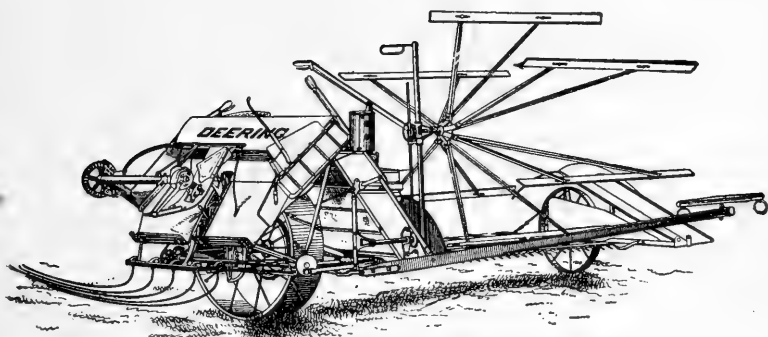
The twine-binding harvester has more capital invested in its manufacture than any other single machine in the world, excepting only the steam engine, and its use in the harvest fields of the world saves the labor of anywhere from five to twenty millions of men, according as it may be compared with the reaper, the cradle or the sickle. From one-quarter to one-third of the world's supply of this eminently useful machine is made in one factory in Chicago, that of William Deering & Co. This is a strong assertion,

but the writer is in position to know the facts, and he makes the statement frankly, especially since William Deering & Co. are the recognized pioneers, first, in the introduction of the harvester, and later, in the development of the twine-binder.

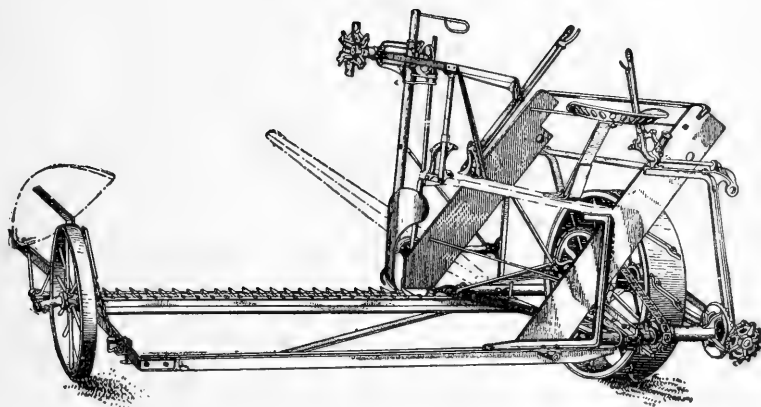
The hand-binding harvester invented by the Marsh Brothers, of DeKalb county, thirty-five years ago, and first put on the market from Plano, Ill., five years later, was the beginning of this industry. Two farmer's boys, familiar only with the reapers then in use in their part of the country, plunged boldly into an unexplored field of invention, a field from which so many had turned back unsuccessful that it was thought to be barren of anything practical. Undaunted by the discouraging advice of older heads, who said a harvester was impossible, they carefully planned their invention, and with only the tools available on a farm and the castings from an old reaper, they built complete in principle and successful in operation, the first Marsh harvester, an invention many times greater in value than other machines produced before or since that required the accumulated efforts of a hundred inventors. In fact, it may be said without fear of contradiction that in the history of invention in harvesting machinery there is no case on record where the conception of the principles to be incorporated in a machine entirely new in form and purpose was so clear in the minds of the inventors, and where the first machine built did as perfect work or required as little later improvement to make it a fully marketable machine. If the invention of the harvester seems romantic in the incidents surrounding it, the subsequent introduction and manufacture of the machine for general use were equally so.

No one took a deeper interest in the pioneer efforts at Plano than did William Deering, and when a few years later he became actively interested in the business, bringing into it ample capital and new ideas, his aggressive and tireless management pushed the harvester trade out into channels that it had hitherto been unable to reach. By 1879 the demand for harvesters and wire-binders had grown to such proportions that Mr. Deering saw the business could not longer be handled with the facilities available at Plano. Gammon & Deering had in 1874 begun the manufacture of Gordon wire-binders, and Mr. Deering seemed to see more clearly than any one else connected with the industry the impetus that would be given to the demand for harvesting machinery could a successful twine or cord-binder be perfected. He had been following closely during the harvest of 1878 the experiments of Appleby, and saw in the twine-binder the machine of the future, and he was not slow to undertake what may be considered as the pioneer work of putting Mr. Appleby's invention extensively on the market. The firm of Gammon & Deering, having followed two of these machines through the harvest of 1878, put out a considerable number of them in 1879, and they worked successfully. In the fall of that year Gammon & Deering dissolved partnership, Mr. Gammon retiring from the firm. The following, descriptive of the later developments of the industry, is from the pen of Mr. Marsh, who had been so long associated with Mr. Deering at Plano:

"The year 1880 was a memorable one in the annals of the harvesting



WILLIAM DEERING & CO.'S TWINE BINDING HARVESTER.



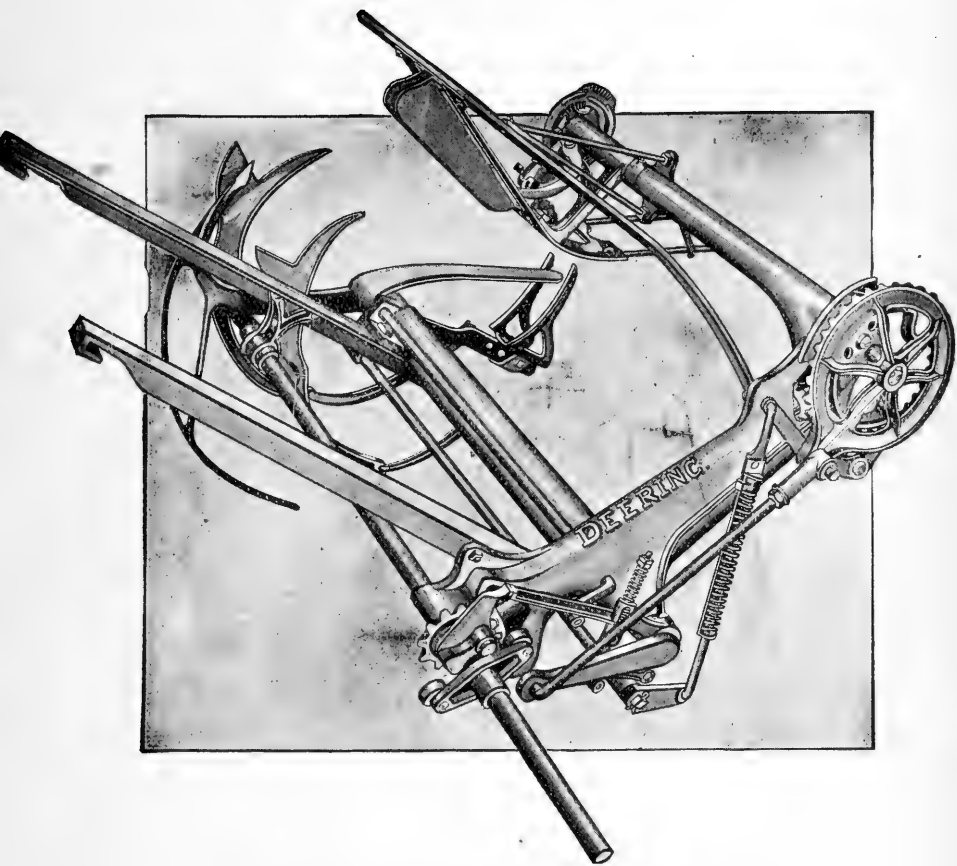
SKELETON OF THE DEERING HARVESTER.

machine business. The old hand-binding harvester had been pushed from its place in the market by the child of its adoption, the automatic binder, several styles of which binding with wire were built and successfully put upon the market to supply a large and growing demand. Mr. Deering was now the sole representative of the vast interests of the old concern, and he was making two bold movements; he was building new shops in Chicago, and removing his works thereto from Plano, thus changing his base and reforming his front in the face of the enemy, and he was preparing to make a charge directly upon the center of the opposing hosts. The position was dangerous and required a leader of judgment, nerve, great executive ability and force of character. These attributes Mr. Deering possessed. The campaign of 1880 ended in complete success; his Appleby binders—manufactured and put upon the market from shops on wheels, so to speak—swept everything before them. The harvest of that year was a Waterloo defeat for the wire-binders, and *sauve qui peut* might well have been the cry of the leaders thereafter as they rushed for cover under the Appleby patents. Mr. Deering won a complete victory; he established twine-binding machines as the grain-harvesters of the time, and of the future, and himself as the acknowledged leader in the movement.

"From 1880 onward Mr. Deering's progress has been steadily and sweepingly upward. The shops have been enlarged year after year, and new departments have been added until now it is one of the largest* and most complete institutions of the kind in this or any other country. In 1883 Mr. Deering had the business incorporated under the title, Wm. Deering & Co., and by this change he is enabled, through the assistance of his sons and others interested, to escape somewhat the cares of constant application to the details of such an immense establishment with its many branches, and one would think that a physical organization apparently not over-strong would have sooner required relief. His two sons, Charles W. and James E., who have been interested in the concern since 1880, and have become thoroughly familiar with the details, have ably seconded their father's efforts, and are fully competent to maintain the ground that he has won."

"One of the triumphs of the 19th century," was the title of a little pamphlet, copies of which were distributed by Wm. Deering & Co. at the Columbian Exposition. It told of the triumph of inventive ingenuity and mechanical skill, embodied in the twine-binder, and in it was told also the story of one who had visited the Deering works, and had made notes of what he saw in the various departments of the wonderful factory. Twenty years ago the iron parts of a machine would have been slowly hammered into form by a blacksmith, but here acres of machinery were set up and were grinding out by the million, with the accuracy of form and size that can only be obtained by a soulless machine, the parts that, when assembled, make up a year's output of harvesting machinery. The Deering factory is a large subject,

*This was written in 1887. Since that time the business of William Deering & Co. has more than doubled, and the works are now the largest agricultural implement factory in the world



THE APPLEBY BINDER, AS PERFECTED BY WILLIAM DEERING & CO.

one that would require a volume to treat adequately. It would be a departure from the purpose of this brief sketch to attempt even the most hasty review of the manner of making a binder. Suffice it to say that every part of the Deering machine is made in their works, thus insuring the highest quality of material and workmanship.

In the main frame of the Deering binder a truss form of construction has been adopted, giving the necessary rigidity with the least weight. The platform is attached to this frame "by long double-grip malleable and steel joints at front and rear, and further strengthened by a rigid main brace, connecting the main frame truss and the inner shoe of the cutter-bar." Next to a strong frame, a properly constructed main wheel is vital in a harvester. The Deering wheel is of bicycle pattern, with suspension spokes bolted in a rigid rim of wood having a steel tire. The grain wheel is of steel, with a malleable hub and a wide tire. A simple device is used for raising and lowering the platform, which is suspended by its corners so as to prevent warping or sagging. The platform is forty-eight inches wide, an unusual width, but designed to give the machine ample capacity in long grain. The canvas is kept taut by a spring, which allows it to contract and expand with changes of the atmosphere. A special feature claimed for the machine is in the elevator, which is fifty-five inches wide and extends seven inches in front of the line of the platform, thus doing away entirely with clogging and choking at the inner end of the cutter-bar, heretofore a weak point in binders. The acme of adjustability has been reached in the Deering reel, a single lever being arranged to raise and lower it, or to shift it forward or back.

The illustration shown of the Deering binder represents fairly the improvements that have been made in this marvelous machine since it was first considered perfect, fifteen years ago. A comparison of this illustration with the cuts in the chapter on Automatic Binders, in the first part of this book, will show to those to whom it may never have occurred, the work that master mechanics in the Deering shops have expended in simplifying its construction and improving its general design.

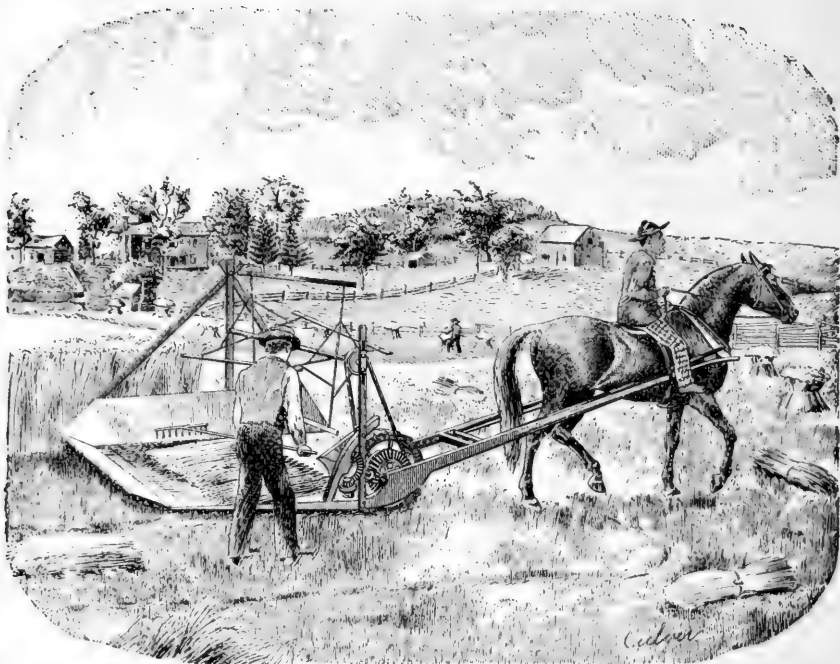
THE McCORMICK REAPER WORKS.

The name of McCormick has become inseparably connected with the invention of the reaper, and a monument of gratitude has been erected to the memory of the man whose work as the pioneer in the reaper industry is destined to pass into history as one of the greatest contributions to human progress. This book is not written to decide the much-mooted question "who invented the reaper?" any further than the comment that appears on that question in the chapter on reapers. It is sufficient for the purpose of this sketch, and for the average man to know, that of the score or more of inventors who, before McCormick's time, saw the vision of a reaper that would harvest the grain of the world, not one was able to arrive at the combination of mechanical principles that would make the vision a reality. Unfortunately, the discussion of McCormick's invention has generally been confined to his patent of 1834, when, in fact, a fully successful reaper, one that was sufficiently practical to be used by the farmers generally, was not produced until twelve years later.

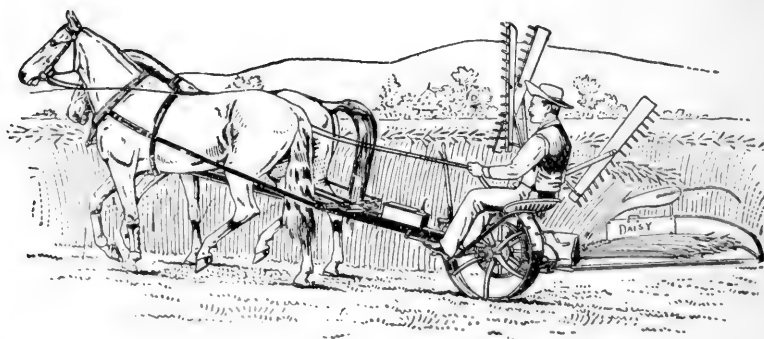
There is probably no case on record, in the history of agricultural implements, of an inventor who surmounted greater obstacles, or who showed more heroic persistence in the development of an idea, than Cyrus H. McCormick. The world has produced few such men in any branch of industrial life. Mr. McCormick found the world cutting its grain with sickles; he left it with reapers in use on a million farms. After a struggle with adverse conditions extending over fifteen years, during which he built experimental machines in different parts of the country, he succeeded, in 1846, in making, at Brockport, N. Y., 100 machines that were put in the farmers' hands and successfully operated, thus laying the foundation for the industry.

Robert, father of the late Cyrus H. McCormick, as early as 1816 built an experimental reaper and tried it on his farm. It was on the "rotary" principle, having a cylinder or drum set upright with a knife projecting from its lower end or edge. It proved unsuccessful, but it is said that he continued the experiments in later years and produced a machine with a reciprocating knife, the idea of which served as a nucleus for the invention of his son, in 1831. After Cyrus H. McCormick had finally demonstrated at Brockport the success of his reaper, he came to Chicago, in 1847, and began his remarkable career as a manufacturer. This business was continued by him until late in the "fifties," when he was joined by his brothers, Leander J. and Wm. S., and on the death of William S., a few years later, the firm became C. H. & L. J. McCormick, which style was retained until 1879, when the business was incorporated as the McCormick Harvesting Machine Company. Later, the stock of L. J., a fourth interest, was purchased by the estate of Cyrus H., which now owns the business.

From the beginning the house has confined its attention to machinery for harvesting grain and grasses. In 1875 they began making harvesters, and, soon after, automatic wire-binders were put out. In 1881 they took a license under the Appleby patents, and have since been making twine-binders of the standard type, substantially the same as those made by all manufacturers who have operated under the Appleby patents.



THE ORIGINAL McCORMICK REAPER OF 1831.



THE McCORMICK REAPER OF TO-DAY.

THE "AERMOTOR" AND THE AERMOTOR COMPANY.

The latest branch of the agricultural implement industry to experience a revolution is the manufacture of windmills. The change has been brought about by the invention and introduction in the trade of the steel back-gear'd mill and steel tower, and the results promise to be far-reaching. Since the first introduction a generation ago of the two classes of wooden wheels generally manufactured in America, the sectional and the solid, there has been little change in their general design, improvements being possible only in details and in adaptations of their fundamental principles. To the casual observer the recent revolution may not seem so clear, as the solid form of wheel and the vane have been retained in the new style, in the smaller sizes at least; but the change has come through the addition of two new principles to the old combination, increasing the efficiency of a mill of a given size 50 per cent or more, and materially lessening the cost of manufacture. In brief, this new principle consists, first, in eliminating as far as possible all obstructions to the wind that arise from the use of wooden slats and arms, and substituting for the thick, narrow slats of the old form of construction a lesser number of wide steel slats or fans, curved so as to convert into power the full force of the wind, but presenting as an obstruction to its passage only a thin, knife-like edge of steel; and second, in gearing back the wheel so it will expend three revolutions in one stroke of the pump, thus taking advantage of the lightest wind, and getting a higher rate of efficiency out of a moderate or strong wind; without strain upon the framework or tower. The pioneers in this revolution are T. O. Perry, the inventor of the new principles, and L. W. Noyes, the founder and present head of the Aermotor Company, the new windmill having become known in the trade as the Aermotor.

It may be said in advance that the Aermotor is the invention, and design of a mechanical engineer, in sharp contrast with many other inventions in the agricultural implement industry that are the result of a moment's inspiration or a crude experiment, often on the part of an unlettered farmer. It is said that in the exhaustive experiments that were conducted to determine the best design for the Aermotor, over 5,000 dynamometrical tests were made on sixty-one different forms of wheels, propelled by an artificial, and therefore uniform, wind. By these experiments many questions relating to the proper speed of the wheel were determined: the best form, angle and curvature and amount of sail surface; the resistance of air to rotation; obstructions in the wheel, such as wooden arms; obstructions before the wheel, as in the vaneless mill, and numerous other more abstruse, though not less important, questions.

Exhaustive work of this character might be expected to bear fruit, and that it has done so in this case may be seen in the enormous demand that has developed for the new wind engine, an expansion of manufacture that can only be compared to the development of the harvesting machine trade following the invention of the twine binder.

The first Aermotors were put on the market in 1888 by L. W. Noyes, of Chicago, but as only forty-five mills were made in that year, it may be said that the beginning of the industry was in 1889. Mr. Noyes was well equipped

for the trying work of "pioneering" the new invention. He had begun in 1876 in the implement and hardware trade, establishing in that year a line of manufacture that is still successful.

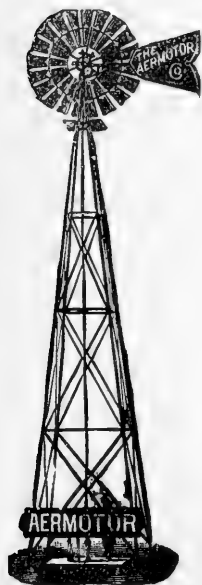
In 1879 Mr. Noyes invented a dictionary holder, coining the term for it, and began its manufacture on a scale that has brought it into general use. Altogether Mr. Noyes has taken out a hundred or more patents, many of them in the harvesting machine industry. His experience in the wind-mill industry extended over several years, with one of the pioneer houses in this line, and gave him a knowledge of the field that has since proved invaluable.

Soon after the business was established it was incorporated under the name of the Aermotor Company. The name Aermotor had been selected by Mr. Noyes, and the business was organized and has grown up under his able management. The popularity of the new mill is well shown by the growth of its manufacture. At first only one floor was occupied, the fourth at 42 and 44 West Monroe street, in Chicago. The next year, 1889, the business was moved to the six-story building at 110 and 112 South Jefferson street, the company taking a five-year lease, and believing the building large enough for several years to come. Within a year, however, the facilities were found inadequate, and in November, 1890, the company moved to its present location, at Rockwell and Fillmore streets. A much larger building was erected here, but still further extensions were needed, and in 1891 four acres of land adjoining were purchased to make room for new buildings. The facilities for manufacturing are now complete, comprising a foundry, a galvanizing plant, and a full equipment of special machinery for stamping, shearing, punching, riveting and the various processes through which the steel plates, angles and other materials must pass to become parts of complete Aermotors.

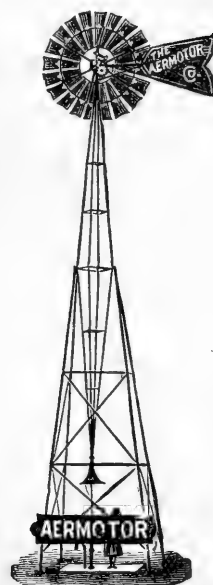
An inspection of this plant forces upon one the conclusion that the greatest field for inventive and organizing ability at the present time is in factory methods and processes. Once a revolution has passed in the principles and construction of an implement, but little improvement may be made for a generation except in minor details; but in the factory producing that implement, if it is under progressive management, there is a continual change in methods for accomplishing a certain result. Machinery must replace slow and tedious hand labor at every point, and machines that have not been used enough to wear them appreciably, must be discarded for something new of greater capacity and efficiency. In this way only can the cost of manufacture be reduced to a minimum, so the factory in question may lead in competition in its industry. The Aermotor factory is remarkable for the improvements that have been made in every department. In the foundry, for example, devices for expediting the moulder's work have been adopted, increasing a workman's product from six to sixteen pieces per day in one case, and from twelve to forty-five in another instance; these devices also improving the quality of the product. In every detail of the work carried on in this factory the same system and organization appears, looking to decreased cost of production and higher quality of the product. As a result of these improvements, and of the advantages inherent in the new princi-



THE AERMOTOR STEEL BACK-GEARED WIND-MILL.



THE STEEL TOWER.



THE TILTING TOWER.

ples of the Aermotor, the claim is made, with reason, that the cost of wind power—the cheapest power known—has been reduced to one-sixth of what it was a few years ago. It has been made possible to greatly increase the use of windmills by bringing the price within the means of a greater number of purchasers.

No agricultural implement serves the farmer in more varied ways, or makes itself more generally useful than the windmill. Its chief mission in the past has been the pumping of water for the household and for stock, and in this it has proved a blessing indeed to humanity. But the introduction of the steel mill promises to bring within the reach of every farmer a source of power that will be of inestimable value to him, in grinding feed for his stock, and in a dozen other lines of farm work for which light power is required. Wooden windmills have, in fact, been applied to a considerable extent to these uses, but the ability of the Aermotor to run in light winds more than doubles the average time when the power is available.

The decreased cost of wind power that has come from the introduction of steel has given a new interest to the question of using windmills in irrigation. The farmers of the far west, and especially in the arid regions, where they already depend upon irrigation, have been experimenting for many years with windmills, but the cost of a pumping outfit for a farm has been too great for profitable results. It has been demonstrated, however, that millions of arid acres in the western half of the United States are underlaid with strata of water-bearing sand or gravel, furnishing an abundant supply of water, often quite near the surface. Undoubtedly the steel windmill will play an important part in the near future in reclaiming this vast area. It is generally conceded by the advocates of irrigation that all the land immediately adjoining streams of water in the west has been taken up, and that the opening of areas of any extent in the future depends, on the one hand, upon building long and costly ditches and other engineering works, and on the other hand, upon the general introduction of windmills.

In this connection it is of interest to note calculations of Prof. R. H. Thurston, of Cornell University, on the amount of energy that is developed by the atmosphere. Says Mr. Thurston: "The magnitude of the store of aerial energy upon which mankind may draw so long as the race exists upon this earth, is beyond the reach of the imagination to conceive, but not beyond the power of computation of the mathematician. * * *

The atmosphere weighs about a ton to every square foot of the earth's surface. * * *

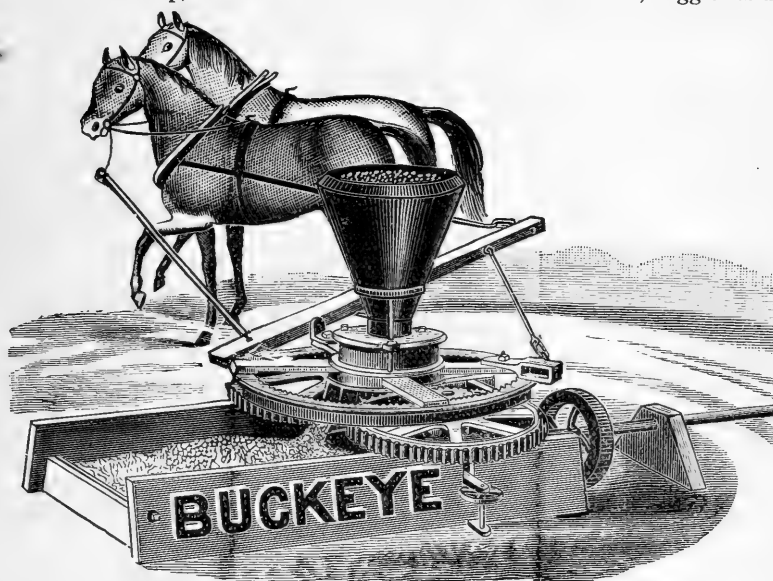
Its energy is that due to motion at velocities varying all the way from the gentlest zephyr to the hurricane and cyclone, rushing over the prairie or along the surface of the sea at more than 100 miles per hour. * * *

Assuming the moderate velocity of 16.7 miles an hour for the whole atmosphere of the globe, its energy per mile is * * *

certainly more than half a million times as much power as have all the engines in the world combined. Each cubic mile would store 40,000,000,000 horse power; and every square mile, could 100 feet of its superincumbent atmosphere be utilized, would yield about 80,000,000 horse power, which is not far from the aggregate of the existing steam power of the world."

THE STAVER & ABBOTT MANUFACTURING COMPANY.

As indicated briefly in the chapter of this book devoted to feed grinders, the Buckeye combined feed mill and power was introduced in the trade by H. C. Staver, of Chicago, founder of the Staver & Abbott Manufacturing Company. Mr. Staver had been associated with Geo. K. Smith, the inventor of this mill, and recognizing its value he acquired the patents on it and undertook the pioneer work of putting it on the market. The H. C. Staver Implement Company was organized in 1884 to manufacture it in connection with other lines of agricultural implements. A large business was built up, and in time the manufacture of road carts, buggies and



THE BUCKEYE COMBINED FEED MILL AND HORSE POWER.

other vehicles was added. In the fall of 1890 the business was consolidated with the Abbott Buggy Company, and its operations were still further extended, the capital stock being increased to \$400,000.

Mr. Staver's life has had its full share of hardships and romance. He began in the agricultural trade in Wisconsin some twenty-five years ago, where his first employment was as a canvasser for a patent clothes line. After working two months and earning \$120 in commissions, his employer, who had looked after the collections, left for parts unknown, leaving the young man with a board bill and other debts he had incurred. Securing work in a hotel, his attention was one day attracted by a party of men in the street who were unsuccessfully attempting to set up a reaper. He showed them how to get it together, and this led to the offer of a position as canvasser and reaper expert for a local firm. From this beginning he gradually rose, working as traveling salesman for the Marsh harvester, and later in 1875 going to Kansas City to engage in the jobbing trade, where he remained until 1879. He then became secretary of the J. I. Case Plow Company at Racine, Wis., remaining there until he began manufacturing in Chicago.

THE FAMOUS MANUFACTURING COMPANY.

The development of the hay press industry in the west has been largely dependent upon the growth of cities like Chicago. This city has more than doubled its population in the past ten years and other western cities have grown at almost as rapid a rate. The market for baled hay has widened in a corresponding degree and absorbs at the present time a large proportion of the hay crop, with a promise of taking a still greater share in the next few years.

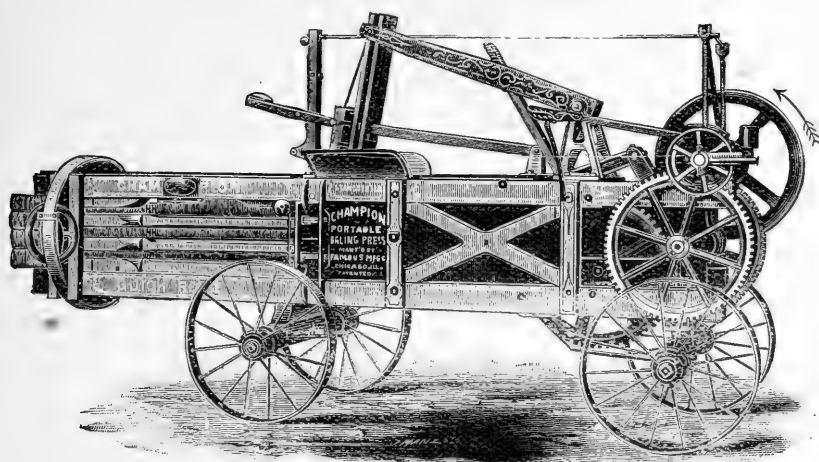
Quincy, Ill., is the pioneer city of the west in the manufacture of hay-presses. It was here that the first upright large bale-beater presses were made, this pioneer step leading to the introduction of horse-power horizontal presses and other improvements.

One of the pioneers who began at Quincy, was Andrew Wickey, the founder of the Famous Manufacturing Company, now of Chicago, the oldest western manufacturer in this line represented at the Columbian Exposition. Mr. Wickey had been engaged in the jobbing of agricultural implements at Quincy, and, seeing the need of a convenient portable press that could be used by farmers so they could take advantage of the market for baled-hay, he began manufacturing in this line in 1881. The first press which he introduced was known as the Champion side discharge press, with coggled-segment double acting power. The chamber was fitted with a pressure-gauge and when the bale had reached its full size and had been tied, it was discharged by the rotation of the pressure-gauge, which presented its reverse end for a new bale. This press was manufactured on quite a large scale. Following the introduction of the Champion side discharge, Mr. Wickey designed an upright pattern of press known as the Common Sense. It had many devices in common with the Champion side-discharge horizontal press, but used a capstan power. The next and most important change consisted in dispensing with the side-discharge principle and the pressure-gauge and substituting a perpetual bale-chamber.

In 1887 the Famous Manufacturing Company brought out the Champion belt-power press, being the first steam-power press manufactured in the west, and in 1888 the Champion four-horse detached power press, and also an attached power-press. In the same year the company introduced the Champion two-horse full-circle press, a machine constructed entirely of iron and steel, which has had a large sale. Having from time to time greatly increased the number of styles and sizes as demanded by the trade, they now make upwards of twenty different styles of presses.

In the fall of 1892 they perfected the self-tying attachment for the Champion press, a radically new invention in the hay-press industry, and one that promises to have far-reaching results. It takes the wire from the coil, passes it around the bale and fastens the ends together, the entire operation being automatic, thus reducing the help required as also the cost of the wire.

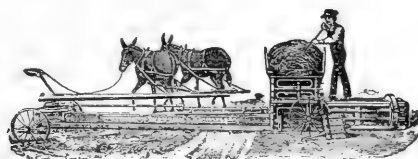
The business established by Mr. Wickey was incorporated in 1883 as the Famous Manufacturing Company and so continues. In 1889 the company removed to Chicago, increasing its capital stock to \$100,000, and erecting large and complete works.



THE CHAMPION BELT POWER BALING PRESS.



CHAMPION DETACHED POWER BALING PRESS.



CHAMPION TWO HORSE CONTINUOUS BALING PRESS.



CHAMPION REVERSIBLE LEVER BALING PRESS.

Rockford, Ill.

EMERSON, TALCOTT & CO

J. H. MANNY laid the foundation for the reaper business of Rockford, Ill. At the time of the invention of his reaper he was farming with his father at Waddams' Grove, Ill., near Rockford. They had a large crop of wheat, and wanted a machine to cut it, and they heard that Geo. Esterly, of Wisconsin, was making machines that would harvest grain. They visited Esterly to buy one of his machines, but found that he would probably not be able to get one finished for them in time for their harvest. John H. Manny, who was then a very young man, remained with Esterly at his shop to help him complete the "header," which he undertook to furnish for them, and thus had his first insight into the construction of harvesting machinery. They brought this header home and used it successfully, making a number like it for sale the next year. Subsequently John H. Manny conceived the idea of making a reaper, and after the trials incident to an inventor who undertakes so great a task he succeeded in bringing out a practical machine. There were no railroads through the country at this time, except a line to Rockford, and John H. Manny and those interested with him in building his machine came to Rockford to buy their hardware, which was furnished to them by the firm of Blinn & Emerson. This was in 1852 or 1853. In the fall of 1853 they concluded to locate at Rockford permanently, John P. Manny coming with his brother as an employee. Subsequently, in the spring of 1854, Wait and Sylvester Talcott became interested with Mr. Manny under the firm name J. H. Manny & Co., and they manufactured a considerable number of combined reapers and mowers for the harvest of 1854. In the summer of 1854 a new firm was organized under the name of Manny & Co., consisting of John H. Manny, Wait and Sylvester Talcott, Jess Blinn and Ralph Emerson, who manufactured for the harvest of 1855 and 1856 about 6,000 machines. John H. Manny died in 1856, and the manufacture of his machines was then carried on by Wait and Sylvester Talcott and Ralph Emerson until 1860, when Mr. Emerson bought out his partners and associated himself with Wm. A. Talcott. Following the death of Mr. Manny the firm was known as Talcott, Emerson & Co., until the change in the personnel of the firm in 1860, when it became Emerson & Co., who continued the business under this style until seventeen years ago, when it was incorporated under the name of Emerson, Talcott & Co.

Encouraged by the success of their enterprises in building reapers, mowers, binders and Marsh harvesters, various other concerns have at one time or another engaged in the same business in Rockford, the principal of whom was John P. Manny, who started for himself soon after the death of his brother. The Fountain Bros. also began in this line about

1856 and built a considerable number of reapers, but became involved and retired from the business. W. A. Knowlton, first as agent for John H. Manny's widow and subsequently on his own account, carried on the manufacture of reapers and mowers until he also became involved and retired. Various other attempts to manufacture reapers and mowers were made, but none of them have been successful except the continuous enterprise in which Mr. Emerson became interested in the fall of 1854, and with which he has ever since remained identified.

In 1861 W. W. Burson brought to Rockford and showed to Emerson & Co. a wire-binder, which they recognized as the first practical machine that had been produced. The result was that about 1,200 binders were built for Mr. Burson by Emerson & Co., proving to be the first successful grain binders ever put on the market. The machines, as shown by the illustrations in the chapter on "Automatic Binders," were made as attachments to reapers. The cost of wire at this time, however, was very high and the prejudice of the farmers very great against it. Still the manufacture of the Burson binder was persevered in until the invention of the Marsh harvester, on which two men could ride and bind without any cost for binding material. This effectually set aside the attempt to construct and introduce wire-binders. The first Marsh harvesters built by Emerson & Co. were for the harvest of 1867. Subsequently they became very extensive manufacturers of harvesters until this machine in turn was gradually superseded by improved wire and twine-binders.

Going back, now, to about 1870, we find one of the most interesting events in the history of Rockford. Jacob Behel brought to Emerson & Co. the first twine-binder in which the twine was tied into a successful knot by what was then called the "duck's bill" tyer, which drew the two ends of the twine through and made a knot, the device being practically the same as is used on all twine-binders to-day. Recognizing the value of the invention if twine or cord could be secured at a reasonable price, Mr. Emerson spent many weeks going all over the United States in the search for a manufacturer who would make the twine cheap enough for general use in the harvest fields of the world. He met with disappointment, however, as the cheapest twine he could find would cost from 75 cents to \$1 per acre to bind the grain, and this a poor quality of twine, the cost of a twine that he considered strong enough being nearly \$2 per acre. This was fatal to Mr. Behel's enterprise. Had he brought out his invention twelve or fourteen years later, when the cost of twine had materially cheapened, his patent would have been worth several millions of dollars, as it would have controlled the twine-binder industry.

Moline, Ill.

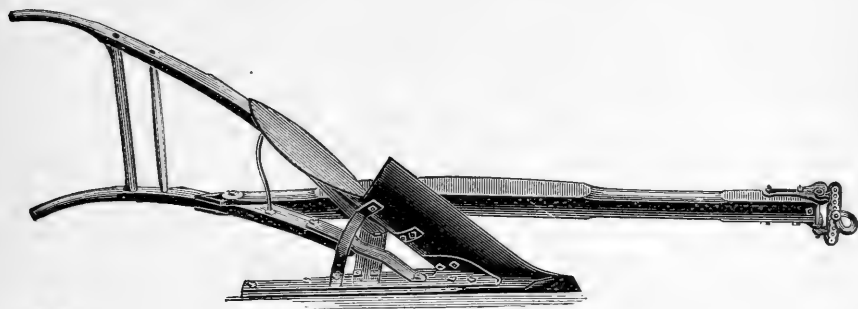
DEERE & COMPANY AND THE STEEL PLOW.

NO city in the west has become more favorably known to the farmers of America and the world as a manufacturing center than Moline, and certainly no city could be more deserving of a high reputation. The steel plow laid the foundation for the prosperity of the western farmer, and he would be ungrateful indeed were he to forget the place in which was developed this most indispensable of all implements. In commercial importance the manufacture of the steel plow stands second among the branches of the agricultural implement industry, harvesting machinery alone taking precedence over it. Considered from the point of view of its usefulness to the farmer in return for the investment, no implement has conferred greater benefits upon agriculture than the steel plow.

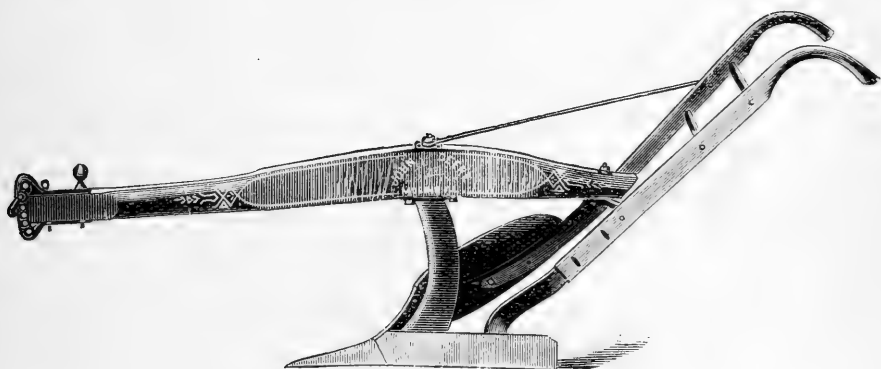
While John Deere was the pioneer in this line, others were in the field at an early day, and there are now a score or more of prominent houses engaged in the manufacture of steel plows. Almost invariably the pioneer in an industry falls to the rear after he has established it and allows others to take a foremost position and the highest honors; but to the credit of the house Mr. Deere founded it may be said that the discriminating demand of a million farmers who seek the best has kept it to the front for over half a century. In no other branch of the agricultural implement industry can a house be found that has made as favorable a record.

The manufacture of steel plows in the west was begun in 1837 at Grand Detour by John Deere, who had moved to the west from Vermont, bringing little with him but a kit of blacksmith's tools and the skill he had acquired during several years spent at the forge. The few people who were then living in Grand Detour were not long in discovering his ability as a mechanic, and "piled upon the floor of his shop their broken trace chains and clevises, their worn-out 'bull tongues' and worse worn shares; and while the young blacksmith hammered out lap rings for their chains, welded their clevises, 'drew out' their bull tongues and 'laid' their shares, his mind dwelt upon the improvement of the plow, the implement of the greatest importance to the pioneer."

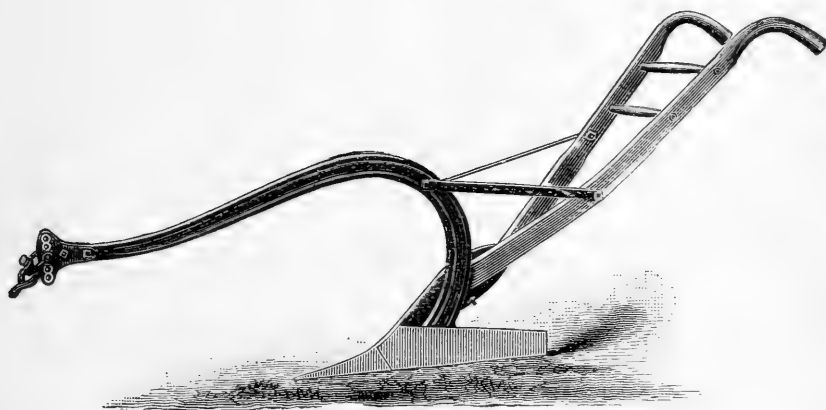
Mr. Deere soon began to make plows, in partnership with Major Andrus, and this gave him a new interest in the problem of making a self-scouring plow. He saw that the wooden mouldboard plows of the time entered the ground with difficulty, clogged up and failed to scour. His first plow had a wrought-iron landside and standard, with a mouldboard and a share of steel cut from an old saw-mill saw and bent over a log shaped for the purpose, the beam and handles being made from white oak rails.



THE JOHN DEERE PLOW.



DEERE & CO.'S STEEL FRAME "RED JACKET" PLOW.

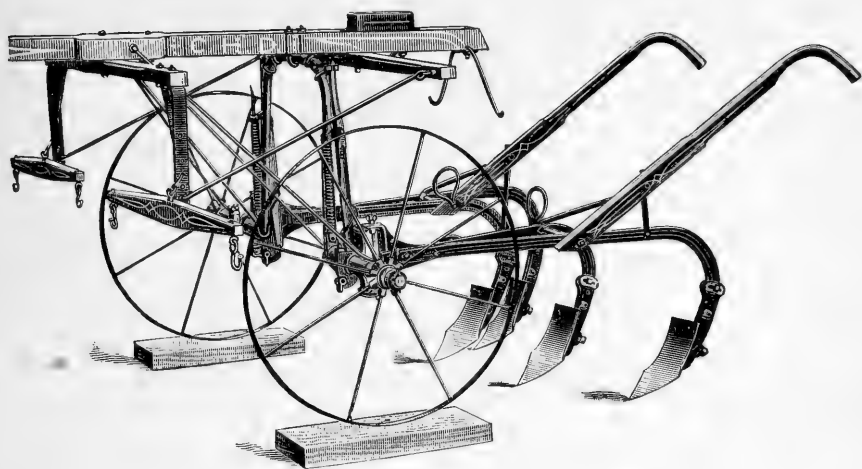


DEERE & CO.'S STEEL BEAM STUBBLE PLOW.

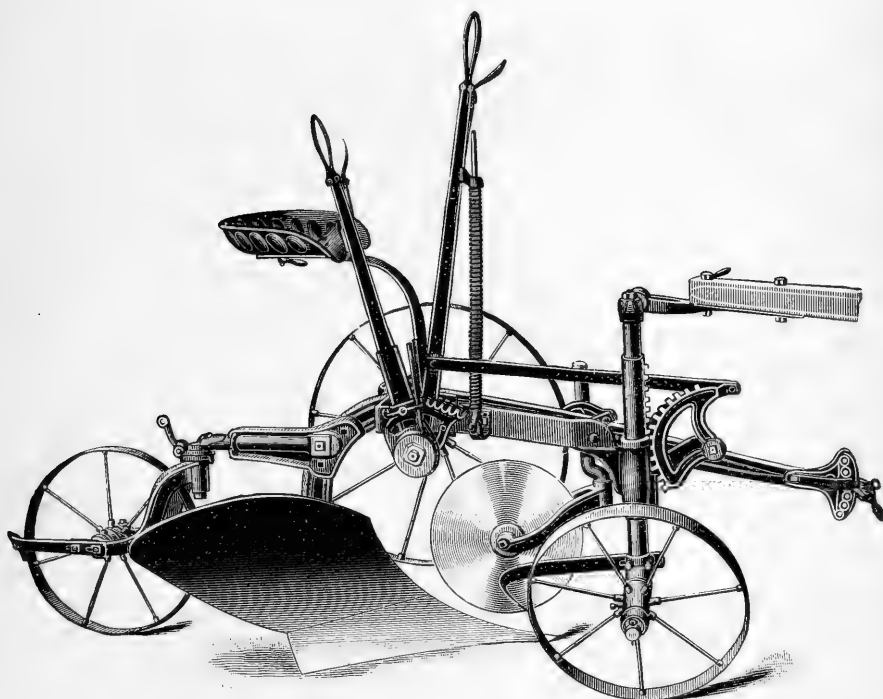
In 1838 two of these plows were made, which aroused considerable interest among the farmers by the excellent work they did. Mr. Deere saw by this time that the successful scouring of a steel mouldboard depended largely upon its curvature, and his next experiments were with a view to making a plow that would scour in land that had been plowed four or five times, especially the black, sticky bottom lands. He visited points in Ogle, Lee, Whiteside and other counties where the farmers had never been able to make a plow scour, and were becoming discouraged, and in 1839 built ten plows. In 1840 he added a second anvil in his shop and made forty plows. In 1841 a brick shop was erected and seventy-five were built, and in 1842 100 plows. In 1845, by erecting a two-story brick shop and adding a small foundry, the firm of Andrus & Deere was able to turn out 400 plows. By this time the difficulty of obtaining steel in the quantity and quality needed had become a serious obstacle in the way of further development. In the course of his search for material Mr. Deere wrote Nailor & Co., importers, of New York, explaining to them the demand of the growing agricultural States of the West for a cast-steel plow, and stated the size and quality of the steel plates he wanted. They replied that no such steel could be had in America, but they would send to England and have it rolled specially for his purpose.

In the meantime Mr. Deere had become dissatisfied with the limited opportunities for manufacturing at Grand Detour, far from the water, then the only means of transportation for material, coal or finished products. Selling out his interest in the business, in 1847, to Major Andrus, he removed to Moline, where he found the advantages of water power, coal nearby in abundance, and cheap river transportation. A partnership was formed with R. M. Tate and J. M. Gould, shops were erected and 700 plows were turned out the first year. About this time the English steel arrived and fifty plows were made of it and sent to different parts of the country where the soil was known to be the most difficult to plow. So successful were they in the field that the demand increased rapidly, and in 1850 1,600 plows were put out, which was considered a remarkable number in those early days.

In 1852 the shops were enlarged and new machinery was put in, and by 1857 the annual output had risen to 10,000 plows. Messrs. Tate and Gould had sold their interests to Mr. Deere in 1853, and he continued alone until 1858, when his son, Chas. H., who had completed his education for a business career, was taken into partnership, and in 1863 Stephen H. Velie, Mr. Deere's son-in-law, a man of considerable experience in mercantile life, also became a member of the firm. In 1862 the manufacture of cultivators was begun, and in time other lines, now known as "plow goods," were added. In 1868 the business was incorporated under the name Deere & Company, with John Deere as president; Chas. H. Deere, vice-president and general manager, and S. H. Velie, secretary. As railroads were built through the west a flood of new settlers came in and the manufacture of plows expanded enormously, the John Deere goods maintaining well the position they had won in the pioneer days. In 1882 the capital stock of the company was increased to \$1,000,000, a further increase in later years mak-



DEERE & CO.'S "C. H. D." CORN CULTIVATOR.



DEERE & CO.'S "KID" THREE WHEEL PLOW.

ing it \$1,500,000. In 1886 Mr. Deere died at the ripe age of 82, and the presidency fell to his son. Both father and son had held offices of honor and public trust, John Deere having served as mayor of Moline, besides taking an active interest in public enterprise and in banking. Chas. H. Deere held the office of Illinois labor commissioner for several years, and has been honored with elective and appointive political offices. He is largely interested in banking and in other investments, still finding time, however, to give general direction to the business of Deere & Company. Mr. Velie continues to hold the office of secretary.

Deere & Company have probably the most complete organization of any house in the west; a fact that augurs well for the future of their business. The following are the officers of the company: Charles H. Deere, president; Charles C. Webber, vice-president; Stephen H. Velie, secretary; Charles H. Pope, assistant secretary; Peter C. Simmon, treasurer; Willard L. Velie, superintendent sales department; William Butterworth, attorney. In the principal jobbing centers strong branch houses have been built up, and from these houses the John Deere plows and associated lines are distributed. The oldest of these houses is the John Deere Plow Co. at Kansas City, Mo., which was established in 1869, under the style Deere, Mansur & Co., and continued under this organization until 1889, when it was incorporated under the present name. C. H. Deere is president, S. H. Velie, vice-president and G. W. Fuller, of Kansas City, secretary and treasurer. At St. Louis, the firm of Deere, Mansur & Co. was established in 1874 to distribute the John Deere goods and a general line of agricultural implements and vehicles in the southern trade. This business was conducted under the name Deere, Mansur & Co. until 1889, when the Moline interest was purchased by the St. Louis members and the firm was incorporated as the Mansur & Tebbetts Implement Company. The Des Moines, Ia., branch was established in 1877, and has grown to be a large jobbing house, under the name H. H. Sickles & Co. The members of the firm are H. H. Sickles, Deere & Co. and the Moline Wagon Co. Deere & Co.'s house at Council Bluffs, Ia., Deere, Wells & Co., was organized in 1881, and incorporated in 1891, and is one of the best-known jobbing houses in the west. C. H. Deere is president; Morris Rosenfield, vice-president, and Lucius Wells, secretary and treasurer. The Minneapolis house was established in 1881 under the name Deere & Co., with the parent house as a partner with C. C. Webber and W. J. Dean. Lately it has been incorporated as the Deere & Webber Company. The Deere Implement Company, of San Francisco, Cal., incorporated in 1892, was established in 1889. C. H. Deere is president; S. H. Velie, vice-president, and F. W. Vaughn, secretary and treasurer. Deere & Co., also have branch houses at Indianapolis, and other jobbing and distribution centers.

Galesburgh, Ill

GEO. W. BROWN & CO.

ONE of the greatest blessings ever conferred upon humanity was the invention of the modern corn-planter. To the casual observer it may only seem to be a useful implement, saving the farmer considerable time and labor in the planting of his corn, but to the student of agricultural history it is far more than this. Viewed in this light it may be seen that the corn-planter—with the “straddle-row” cultivator that came after it—has been the means of transforming agriculture in the west, and of increasing the production of corn until the yield in the United States in a favorable season exceeds two billions of bushels, enough to feed the bread-eating nations of the world. How much this has been worth, in the increased revenue it has brought to the farmer, in the cheapening of food for the millions in the cities, and in the employment it has afforded for labor in industries dependent upon the corn crop, no one can estimate.

It has almost, if not altogether, doubled the production of corn, by doubling the efficiency of the farmer's labor in planting, and has made independent farmers on free land west of the Mississippi of men who would otherwise be farm laborers in the older states. The corn crop of the west has afforded a considerable share of their traffic to the railroads that carry it to the market, and it has increased enormously the world's supply of beef and pork, bringing abundance to the table of the workingman. The manufacture of implements used in growing the crop has contributed largely to the development of prosperous western cities like Galesburgh, and the handling of the crop or products representing it gives employment to armies of workingmen, as in Chicago, for example, where the meat-packing industries require the labor of 30,000 people, and support four of five times as many.

Important inventions in the agricultural implement industry are almost invariably the accumulation of the efforts of a number of inventors, but the vital principles of the corn-planter were all the invention of one man, George W. Brown. It is true that there were corn-planter patents issued before his, and in some of them may be found suggestions of the devices that he afterwards conceived and put in practice, but all the efforts of these early inventors were given to the production of automatic planters or drills, while Mr. Brown's invention was primarily intended for dropping by a hand lever so that the rows could be placed in check by the operator, to permit of cross cultivation.

Mr. Brown's inventive efforts began about 1848. He was then living at Tylersville, near Galesburgh, where he had settled twelve years before. He was a carpenter by profession, and the farmers for miles around brought

their implements to him to have them repaired. His first idea of a planter was to combine a hopper, and a device for dropping the corn, with a shovel plow, a section of log rolling behind to cover the hills. In the spring of 1851 he made his first practical planter, of the type shown in his patent of 1853. In 1852 he planted sixteen acres for himself and eight for a neighbor, and the same spring began the manufacture of ten planters. He only had the means to finish one of them, although he had sold everything on his farm to raise the money necessary for it and for securing his patents. Becoming desperate he sold his farm, went deeply into debt for more money, and staked all upon the success of his invention. Times were hard, and soon he was so much involved that had he been called upon to pay his debts he would not have had a dollar left. He commenced manufacturing at Shanghai, Ill., and in 1853 completed twelve machines, one of which that season planted 300 acres of corn. In 1854 he made 100 planters, and in 1855 300, after which he removed to Galesburgh.

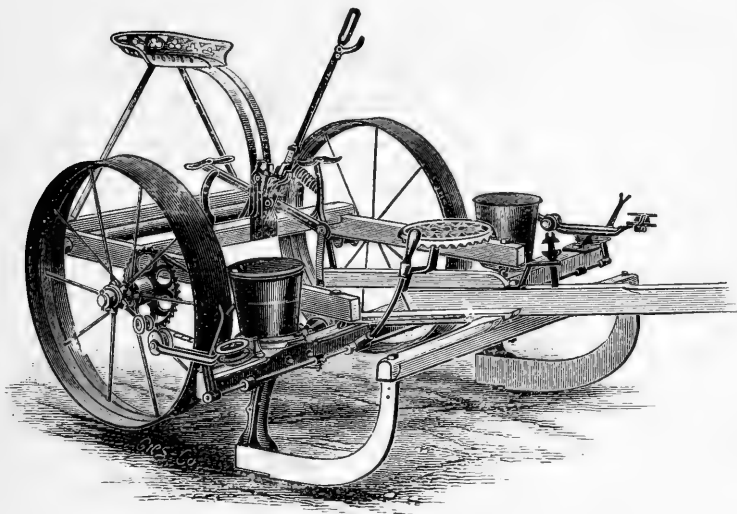
The business was now fairly established, but it was of slow growth. Every one knew that corn when planted with a hoe would come up, at least if the seed was good, but would it grow when run through the hopper of this new-fangled machine? All could see that the machine would run "very prettily" through the field, but did it leave the corn in the right place, and in the proper quantities? Was it well covered and would it grow? These questions were seriously asked, foolish as they may seem to the present generation. For ten or twelve years the planters could only be sent through the country on wagons and sold by agents or canvassers, who were prepared to demonstrate in the field the operation of the new implement. So great were the expenses of introduction that ten years after Mr. Brown had begun manufacturing he did not consider himself worth a dollar. However, the planter trade was gradually developing, and he was building a firm foundation for the future.

During the war the thousands of planters that had gone into use played a part by no means unimportant in raising corn and beef, so much in demand "at the front" when labor was scarce at home. As a well-known public man has said: "Call to mind, if you please, a military hero whose memory humanity has so much reason to bless as that of George Stephenson. The mighty deeds of Alexander and Hannibal, of Caesar and Napoleon—what are they compared with the triumphs of Galileo and Newton, of Stephenson, Fulton and Morse? During his great struggle, comparing France to England, Napoleon said: 'We must overpower her in the end; we have a vastly greater population.' It did not occur to him that England's steam engines, the children of James Watt, represented thirty millions of men. It was these iron men, and not the armies of Wellington at Waterloo, that overcame him. How many men during our war represented in the army McCormick's reapers and Brown's corn-planters; or what would have been the difference in the muster rolls if the wheat had all been cut by cradles and the corn all planted with hoes, when the existence of our great armies depended upon wheat and corn?"

In 1864 the business had become so well settled that it was possible to make a radical change in the system of selling planters. It had been im-



THE BROWN CORN PLANTER IN OPERATION.



THE IMPROVED BROWN PLANTER AND CHECK ROWER.

possible in the early years of the industry to get local dealers interested so they would become active agents, but it was decided to take the bold step of doing away with hired canvassers, and also to discontinue the practice of placing goods in the hands of dealers on commission. The times were good and the change resulted in an enormous expansion of the business, which continued until the factory was one of the largest in the world making agricultural implements.

The record of Mr. Brown's most important patents appears in Chapter IV of the first part of this book. It will be sufficient for this brief sketch of his pioneer work as a manufacturer to mention that the business was incorporated under the name Geo. W. Brown & Co., in 1880, with \$300,000 capital. Mr. Brown took the office of president; I. S. Perkins, who had been his business manager since 1864, was elected vice-president; Jas. E. Brown, treasurer, and Loren Stevens, secretary. M. T. Perrin is now (1893), vice-president and James E. Brown, secretary and treasurer. Mr. Brown, who is now in his seventy-eighth year, is thus able to escape the details of the business, and spends a part of each year in California, enjoying the rest to which he is entitled as one of the foremost of the inventors who have distinguished themselves in the agricultural implement industry of America.

Moline, Ill.

THE MOLINE PLOW COMPANY'S "FLYING DUTCHMAN."

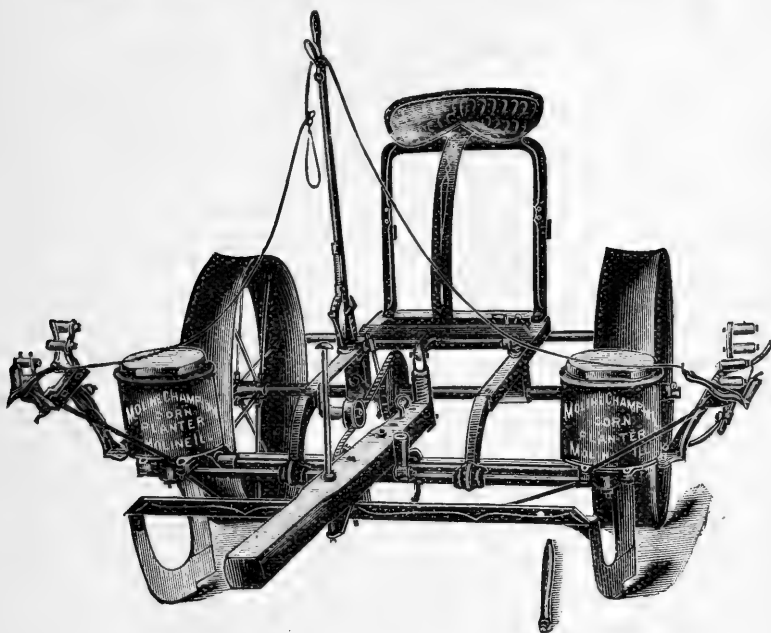
THE three-wheel plow, brought out in 1884, is the most important invention that has been contributed to the plow industry in the past twenty years. The Moline Plow Company's Flying Dutchman was the pioneer in this class. Its distinctive principle is in pivoting the plow at the heel, so it is lowered into and raised out of the ground in the most natural and easy way, by first lowering or raising the point. A compound lever places the control of the plow under the hand of the operator, so it can be lowered and leveled in the furrow by one movement of the lever, or raised and leveled for traveling, the plow taking always a proper position.

The Moline Champion corn planter was the first fully practical "combined" check row planter and drill put upon the market. The successful combination of the drill and planter in one implement was effected by arranging the planter plates so they are rotated by a chain driven from the main axle of the planter. Each hole in the seed plate accommodates but one kernel of corn, which is dropped into the seed tube and held at the heel of the tube ready for its release. For planting in drill the wire is taken off and the check valve tied back so the kernels drop directly into the furrow.

Candee, Swan & Co., in 1866, established at Moline the house that was incorporated in 1870 as the Moline Plow Company. The present officers are George Stephens, president; G. A. Stephens, vice-president; F. G. Allen, secretary, and S. M. Hill, treasurer.



THE MOLINE PLOW COMPANY'S "FLYING DUTCHMAN" THREE WHEEL PLOW.



THE MOLINE PLOW COMPANY'S CHAMPION COMBINED CHECK-ROW PLANTER AND DRILL.

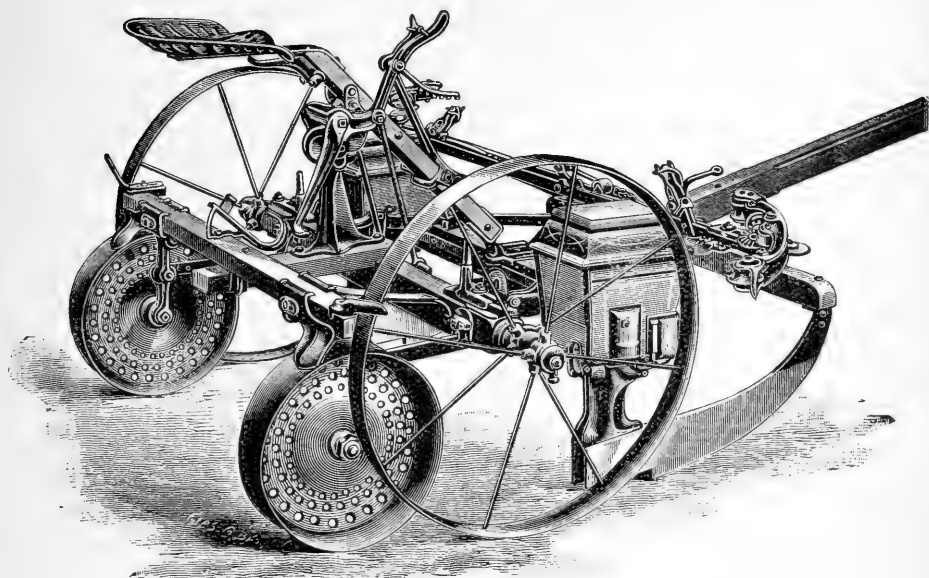
Decatur, Ill.

HAWORTH & SONS AND THE CHECK-ROWER.

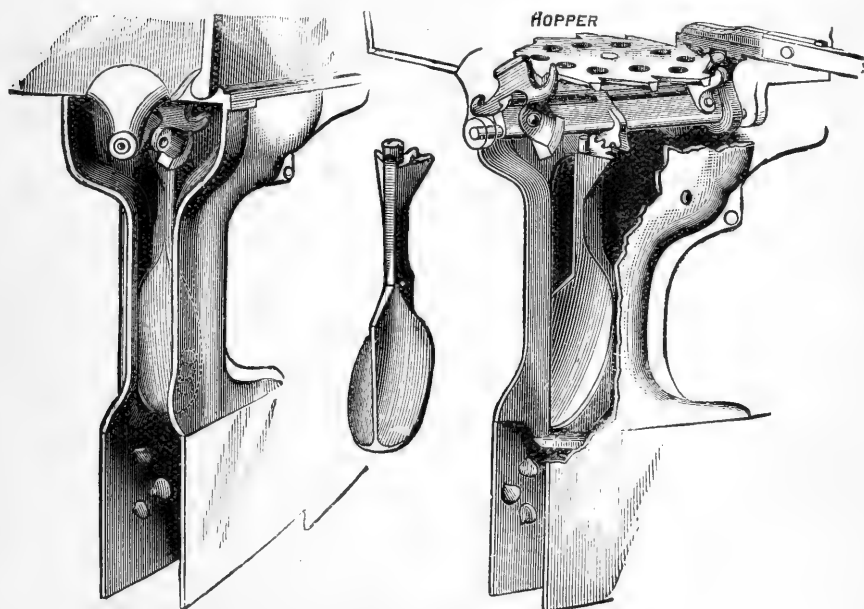
THE most remarkable feature of American life may be found in the methods of our western farmers. Spurred on by the ambition to become independent land-owners and to make comfortable homes for their families, the millions of toilers in the Mississippi valley and the states south and west have provided themselves with one after another of labor-saving implements and machines, until to-day they each do twice to four times the work of a farmer in the older states of the east, who has not equipped himself with the same labor-saving appliances.

The reaper was too slow for the western farmer and he demanded a harvester and was not satisfied until the automatic binder had been perfected. So it has been in the case of implements used in corn-growing, the chief of which is the check-row corn-planter. The old-fashioned corn-planter, when it was first brought into use, was a valuable implement, but it required two men or a man and a boy to operate it, besides the labor of marking, and thus was expensive for the majority of farmers who had no extra labor at hand. The invention of the check-rower saved three-fourths the labor of planting, and proved a boon indeed to the farmers in their battle against the adverse conditions that have prevailed during the last fifteen or twenty years. For this improvement the farmer is indebted to George D. Haworth, of Decatur, Ill., the practical inventor who developed it, and to Haworth & Sons, the pioneer manufacturers who brought it into general use.

George D. Haworth began the manufacture of corn-planters at Springfield, Ohio, in 1853, making at first single-row planters or drills. Often at this early day his thoughts turned to the problem of inventing a device that would plant the hills in check, and a few years after he heard of the effort of Robbins, a resident of the next county, and this gave him new hope. Nothing came of the Robbins effort, however. The use of a chain was impracticable, because of the high price of iron and steel, and Mr. Haworth's experiments with iron wire demonstrated that, aside from its great cost, wire would not last to plant more than fifty acres and was liable to break and cause trouble. Various experiments were made with substitutes, especially after Mr. Haworth removed to Illinois. Hemp rope was tried, and three or four hundred check-rowers were made and sold with a view to using it. But it would stretch after it had been wet, and proved unsatisfactory. However, enough had been done to develop practical devices for use in a check-rower, and it was only a question of time when a practical line or wire would be found. At this time, during the war, cotton rope was very high in price, costing about thirty cents per pound. In time the price



THE HAWORTH CORN PLANTER AND CHECK ROWER.



THE HAWORTH DROPPER AND VALVE.

declined until it reached fourteen cents per pound, and by 1867 quite a manufacturing business was developed by the Haworths, which grew until ten to fifteen thousand check-rows per year was sold, the number running in one year as high as twenty thousand. In 1876 Bessemer steel wire was introduced at a price that made a still larger sale for check-rows, and for combined corn-planters and check-rows, which were first put upon the market about this time.

In addition to the distinction of having been the pioneer in check-rows, Mr. Haworth has originated several valuable improvements and distinctive principles. The most important of these is the principle of laying the wire across the planter so as to obviate all "side draft" or weight on one side that would cause the shoe covering it to run deeper than the one on the other side. This feature is controlled by the Haworths by patents which they hold on reversible guides, through which the wire runs across the planter. Another feature is the spring anchor, by which the wire is held at the end of the row. An improvement that has come into general use is the locking device for preventing the recoil of the slide in the dropping mechanism. Still another feature of the Haworth planter is that the tappet is operated by the direct blow of the knot on the line, and requires less power than where it operates by the recoil of the spring against which it has been drawn by the wire.

The conditions under which corn is planted vary from season to season, and a planter that does excellent work under ordinary conditions is apt to meet with the greatest difficulty in an unusual year. Geo. D. Haworth, the founder of the business of Haworth & Sons, and the active head of the house to-day, has made it a life study to produce a planter that should be able to meet all conditions of soil and planting. As a result of his experience the Haworth planter has many principles not enumerated above that are in a large measure accountable for its success in the trade.

The main wheels of the planter are aided in covering by two small auxiliary wheels, which run directly behind the shoe. Some of the advantages claimed for this design are that the seed will not wash out on rolling land, and mice or vermin cannot follow the rows; the wheels work near the runners and the pulverized soil is fed in so as to completely envelop the seed, leaving it packed just enough to insure quick germination; and in a depression or dead furrow the planter will place the corn at the same depth as on level ground. With this covering device the soil is first crowded into the furrow from one side, the covering wheel then filling and packing from the other side, and in this way it is possible to completely fill the furrow with finely pulverized earth.

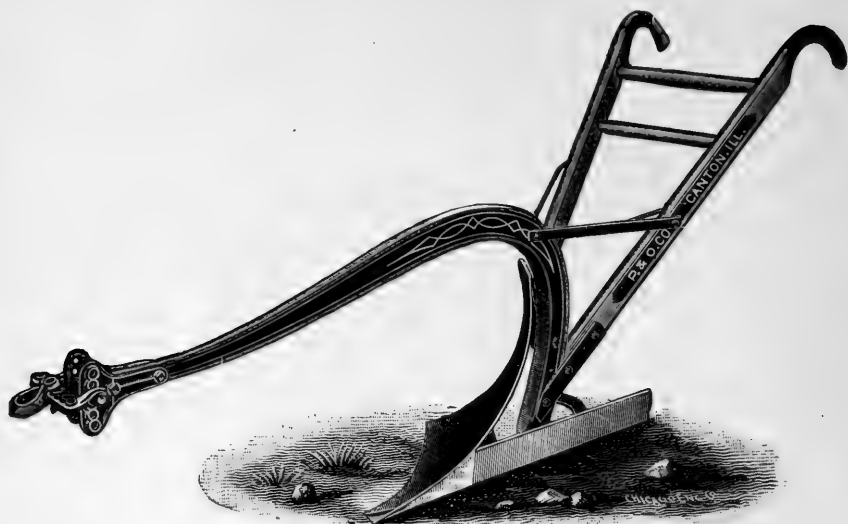
Canton, Ill.

THE PARLIN & ORENDORFF COMPANY.

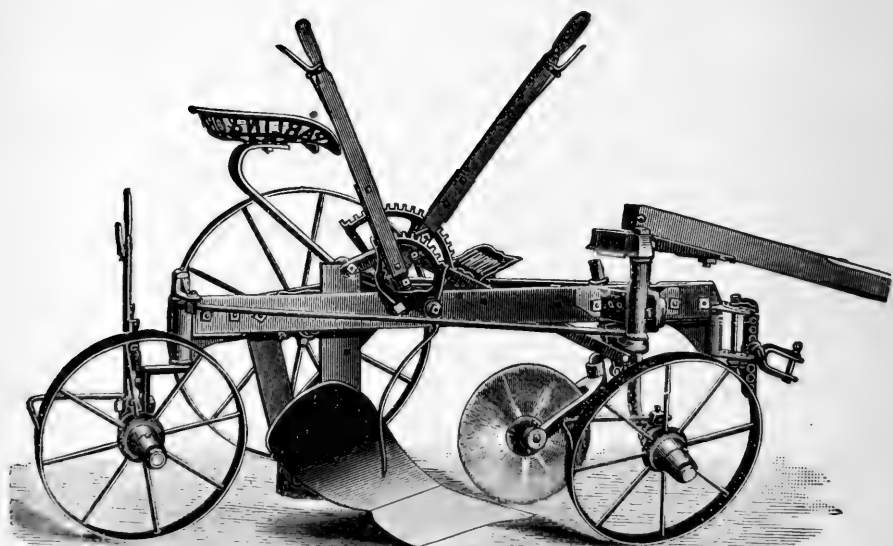
ILLINOIS stands first among the States of the Union in the manufacture of agricultural implements. It was on the fertile prairies of Illinois that the most important of our modern implements were invented and developed, and it is in this State that the largest factories for their production have been built up. One of the most interesting fields of work for the historian of the future will be found in the development of agriculture in this and other western States during the past half century and the subsequent development of industries that are based upon agriculture. In the lives of our inventors and pioneer manufacturers, for example, may be found much that is interesting to the general reader and of inestimable value to those who seek the source of the enormous gains the west has made in wealth and in the ability to produce the means of subsistence. Volumes might be written for each of a score or more houses that were established forty to fifty years ago, that have sent out in ever increasing streams the implements needed by the farmer to lighten his labor and increase his earnings.

In Canton, Illinois, is located the oldest permanent steel plow factory in the United States, and, so far as the writer knows, the oldest permanent agricultural implement factory in the west. It was established in 1842 by the late Wm. Parlin, who was a thorough blacksmith, having served a regular apprenticeship in the east, and had the requisite energy and ability to rise in his calling and become a leader in the west in the manufacture of a general line of agricultural implements.

Mr. Parlin came to Canton in 1840 from Massachusetts, after having worked at his trade one year in St. Louis, Mo., arriving at Canton with only 25 cents working capital and his tools, but with a determination to earn his way to success. He had reached Canton by way of the Mississippi and Illinois rivers, walking ten miles from the nearest landing to the village, July 4. He immediately established a blacksmith shop and began doing the local work incident to his "trade." The first article that he made was a "fro" for splitting lath from oak timber for building purposes. From this beginning his patronage grew, and during his leisure time he began to make plows. The first that he turned out had wooden mouldboards, with steel shares cut from old saws; but "boiler plate" was also used for the mouldboards of some of his plows, and in 1842 several were made with steel mouldboards and landsides. These proved so welcome to the farmers that he found it necessary to employ extra help in turning out plows, and the original shop, a small, rude building, was enlarged again and again, until in 1846 a small foundry was added.



THE CANTON CLIPPER STEEL BEAM PLOW.



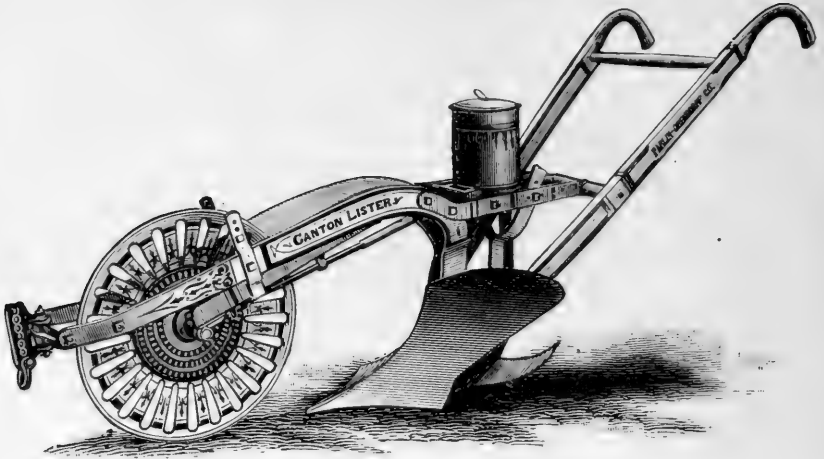
THE CANTON CLIPPER TRICYCLE PLOW.

In the winter of 1847-48, however, his entire plant was swept away by fire, and he found it necessary to begin again in a small way. His first brick building was erected on the site of the present works in 1849, a 20x60 structure, one story high, and Mr. Parlin's facilities for manufacturing were thus considerably increased.

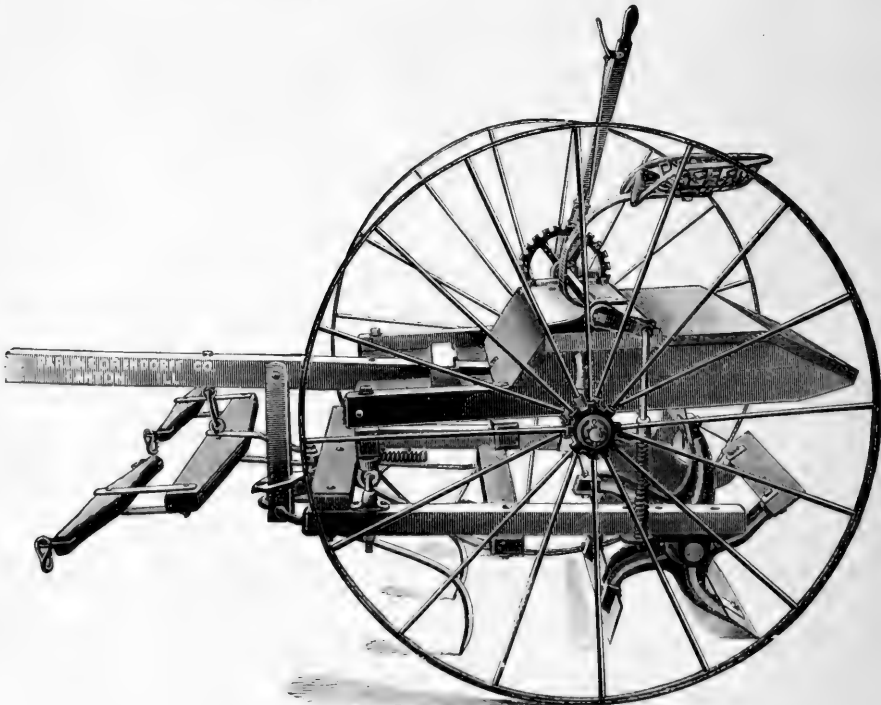
The business was conducted by Mr. Parlin alone until 1852, when Wm. J. Orendorff joined resources with him under the firm name of Wm. Parlin & Co., and preparations were made for still further enlarging the business. The horse-power that had been used for running their grindstones and other machinery was discarded and steam-power employed. About this time the Clipper style of plows was designed and introduced, bringing before the farmers of the west an implement that still stands at the head after the lapse of over 40 years. But as their output increased the new firm found it up-hill work extending their business beyond the limits they had hitherto worked. Transportation facilities were poor, as it was necessary to get material from and finished goods to the Illinois river, ten miles away.

"Selling goods at that time was quite a different process from what it is to-day," said Mr. Orendorff a few years ago to a newspaper man who was interviewing him. "I used to load up a platform wagon built for that purpose and drive out to the principal towns seeking customers, until my plows were either sold or consigned to country merchants, when I would return to Canton, catch up with my books and office work, and do the same thing over again. As our facilities were increased we had to go farther away to sell our plows. We then took them to pieces and loaded into wagons and drove into far-off territory. Upon one trip with three wagon loads I remember driving for some days without much success. Stopping one evening at a 'tavern,' I noticed a stranger with his feet resting against a jamb of the fire-place; and after learning with what we were loaded, he opened up the conversation by asking me what I was going to do with those plows. Upon telling him my purpose, he said, 'Better take them over to my place and I will sell them for you; my place is at Knoxville, Iowa.' A few days later it began raining, and the roads, never good, were abominable. We drove into Knoxville, found Mr. Cunningham to be all right, left three loads, or nearly 100 plows, with him and returned home. The next spring he sold them all and paid the cash. We also found markets for our product by shipping them up and down the Illinois, Mississippi and Missouri rivers by boat, I frequently going along selling or consigning a few of them at the different towns as the boats discharged and loaded other freight, until all were disposed of. In the spring of 1855 I went with a cargo down the Illinois river to St. Louis, and up the Missouri as far as Kansas City, then little more than a landing, and there established a trade in that country that has had a satisfactory and continuous growth, extending all over the great southwest and west to the Pacific coast."

This energetic work in the introduction of their plows naturally led to further enlargements of the shops, and they began the manufacture of other agricultural implements than plows, beginning with walking-cultivators and shovel-plows in 1856, stalk-cutters in 1857, and other implements as the necessity arose or favorable opportunities presented. In 1865 their first



THE CANTON LISTER.



THE CANTON STALK CUTTER.

riding-cultivator was put on the market. The following year their foundry was enlarged and additions were made to other parts of the works. The first lister ever manufactured for the trade was built by Parlin & Orendorff at Canton. It was the invention of a Missouri blacksmith, who succeeded in interesting this firm in the new method of planting corn in the west. So great was its popularity that during the first year the listers were sent out as soon as finished, some by express, and many of them before the paint had dried.

In 1862 the first railroad was built to Canton, the Chicago, Burlington & Quincy. This made them independent of water transportation, and their shipping facilities were made still more complete by the building of the Toledo, Peoria & Western road in 1868. And as the years rolled on the demand for the celebrated Canton goods has increased and the factory enlarged, until they employ from six to eight hundred men, which, together with their improved machinery, give them almost unlimited capacity in this particular line. The old firm was merged into a corporation in 1880, taking in younger members of the two families under style of Parlin & Orendorff Co., a close corporation. They have this year, for 1894, added many new features to older style of implements, and some new machines, prominent among them the new Canton steel corn-planter and check-rower.

Dixon, Ill.

THE GRAND DETOUR PLOW COMPANY.

THE city of Dixon, one of the best known manufacturing centers in northern Illinois, enjoys the distinction of having the oldest plow factory in the west, that of the Grand Detour Plow Company. The business of this company was established in 1837 at Grand Detour, a town six miles above Dixon on the Rock river, by Major Andrus and John Deere. Major Andrus had come from Vermont and settled at Grand Detour in 1834, and in 1837, when Mr. Deere came west, the two formed a partnership under the name Andrus & Deere. During this year they began to make plows, turning out nine of the crude implements then popular with the farmers. Iron and steel were so expensive at this time and difficult to obtain that the early settlers were obliged to do their work with wooden mouldboard plows, with the possible improvement of covering the wearing surface with pieces of old saws. Soon, however, the new firm were able to make plows with successful self-scouring mouldboards, an achievement that was destined to make Grand Detour famous. All over the Illinois prairies the farmers were meeting with the greatest difficulty, especially in the black, sticky bottom lands, in getting plows that would scour, and in some sections they were almost ready to give up in despair and leave their land. The news that plows could be had at Grand Detour that would scour in any kind of soil soon spread, and farmers came from adjoining counties, and, if the firm had no finished plows on hand, would wait until they could be made. The writer has it from the lips of an early settler in Lake county, 100 miles away, that he drove with his father all the way to the shops of Andrus & Deere to get plows for their neighbors. From this may be learned the value to the farmers of a perfect self-scouring plow.

The first "factory" was merely a small blacksmith shop, and it was only in the third year that they added a second forge, Major Andrus having heretofore done the woodwork, while Mr. Deere did the smithing. In time they were able to set up a horse-power grindstone in a building quite a distance from the shop, the plows being carried back and forth by the workmen. From time to time, however, their facilities were improved, and in the sixth year they put in a steam engine and boiler, other machinery and improvements being added in due time. Soon they were able to supply the demands of the country tributary to Dixon, and plows were loaded upon wagons and sent through adjoining counties, and farmers were induced in some cases to act as agents.

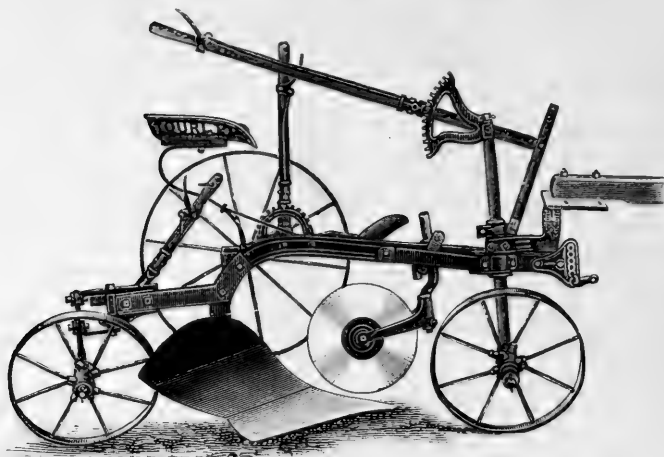
In 1847 Mr. Deere withdrew from the partnership—which had undergone many changes in the parties associated in it with Messrs. Andrus & Deere—and removed to Moline. The business at Grand Detour was then

run for several years by Mr. Andrus alone, but in time Col. Amos Bosworth became interested. Col. Bosworth died in the service in April, 1862, as lieutenant-colonel of the Thirty-fourth Illinois regiment, and in August, 1863, Theron Cumins, now president of the Grand Detour Plow Company, joined Major Andrus. In October, 1857, the factory, which had grown rapidly and was now of considerable size, was burned down, but was at once rebuilt. Ten years later a still greater misfortune visited the firm in the death of Major Andrus. Rising to the occasion, however, Mr. Cumins continued the business alone until 1869, at which time Col. H. T. Noble, of Dixon, became interested as a partner. The firm name changed to T. Cumins & Co., and Col. Noble continued actively in the business until his death, April 15, 1891.

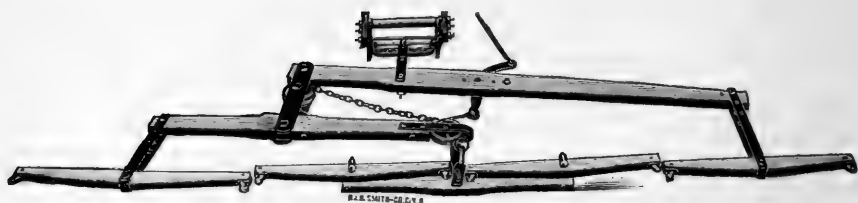
By this time the railroads had been built in every direction through the west, except to Grand Detour, and their influence could no longer be ignored. Dixon had been fortunate in securing two roads, and had grown to be a considerable city, becoming, in fact, the "railroad town" for Grand Detour. Aside from the inconvenience of the old location, transportation to and from the pathway of the "iron horse," on materials and finished goods, amounted to \$4,000 per year. A new factory was therefore erected at Dixon, and the business transferred, their plows, however, retaining the name "Grand Detour." In June, 1874, Orris B. Dodge took an interest in the business, and the firm became Cumins, Noble & Dodge, continuing under this style until June, 1879, when they incorporated as the Grand Detour Plow Company. The present officers are: Theron Cumins, president; Charles H. Noble, vice-president; Orris B. Dodge, secretary and treasurer.

In the meantime the business had grown enormously, and new lines of agricultural implements were added, the most important of which was sulky plows. In 1874 they acquired the Crossley patents on a sulky that had been successfully manufactured since 1871 by parties at Apple River, Ill. This plow became one of the best known of the pioneer two-wheeled sulkies, of which many thousands were manufactured and sold during the "good times" the farmers experienced in the years following their introduction. This style of plow soon gave way to a more modern iron frame two-wheel sulky, named the Grand Detour, which filled a popular demand for half a dozen years, until it made way in turn for the now famous and popular three-wheel plow called the Little Yankee. The manufacture of cultivators, spike-tooth and disk harrows and other implements was added in time, and the business grew until it became one of the largest agricultural implement factories of the west, a position it has since more than maintained.

The Little Yankee three-wheel plow made by the Grand Detour Plow Company was the first three-wheel plow that drew from the end of the beam instead of from the frame in which the beam was held. This manner of hitching gave the same adjustment for depth and width of furrow in a sulky plow that could be had in a walking plow, and was an important improvement in riding plows, especially in making it possible to adjust the suction of the plow to hard or soft ground by changing the hitch, and to



GRAND DETOUR PLOW CO.'S "LITTLE YANKEE."



GRAND DETOUR PLOW CO.'S FOUR HORSE EVENER.



GRAND DETOUR PLOW CO.'S WALKING PLOW.

hold the plow in the ground when the share became worn. Another important feature in a three-wheel plow that was introduced in the trade by the Little Yankee was the inclination of both furrow-wheels against the land, so as to make the plow run steadily, to cut a furrow of even width, to do away with the landside, and to carry the entire weight of the furrow on the wheels.

This plow is also made with two bottoms, known as the Yankee gang, and for use with it a four-horse equalizer has been provided by the company that is in itself an important improvement, one that required a tedious and expensive series of experiments before it was perfected. The difficulty in hitching four horses to a plow is in keeping one horse in the furrow and three horses on the land and at the same time bringing the line of draft somewhere near the end of the beam, so as to obviate "side draft." The illustration shows better than words could explain how this has been effected.

In corn cultivators the Grand Detour Plow Company make six standard styles, walking, tongueless and riding, and have lately acquired the patents on a disk cultivator that has made a record. Disk cultivators as generally made have a tendency to gouge out the corn when it is small, sometimes baffling the most careful driver. This has been overcome by pivoting the carrying wheels of the cultivator at each end of the axle. A foot lever is attached to the spindle of each wheel, and the direction of the cultivator is thus under the perfect control of the driver, so that crooked corn rows can be easily and successfully cultivated.

In the manufacture of disk harrows the company have become well known, and lately they have perfected a steel frame harrow in which the brace is of square hollow steel. The company make numerous styles of spike-tooth harrows. A distinguishing feature which they have patented in this line is a clip for holding the tooth. After a tooth has become worn on its front edge, the bolts which secure this holding clip to the frame may be loosened, and the tooth turned so as to present a new cutting edge; and the tooth may be set up or down as desired when worn.

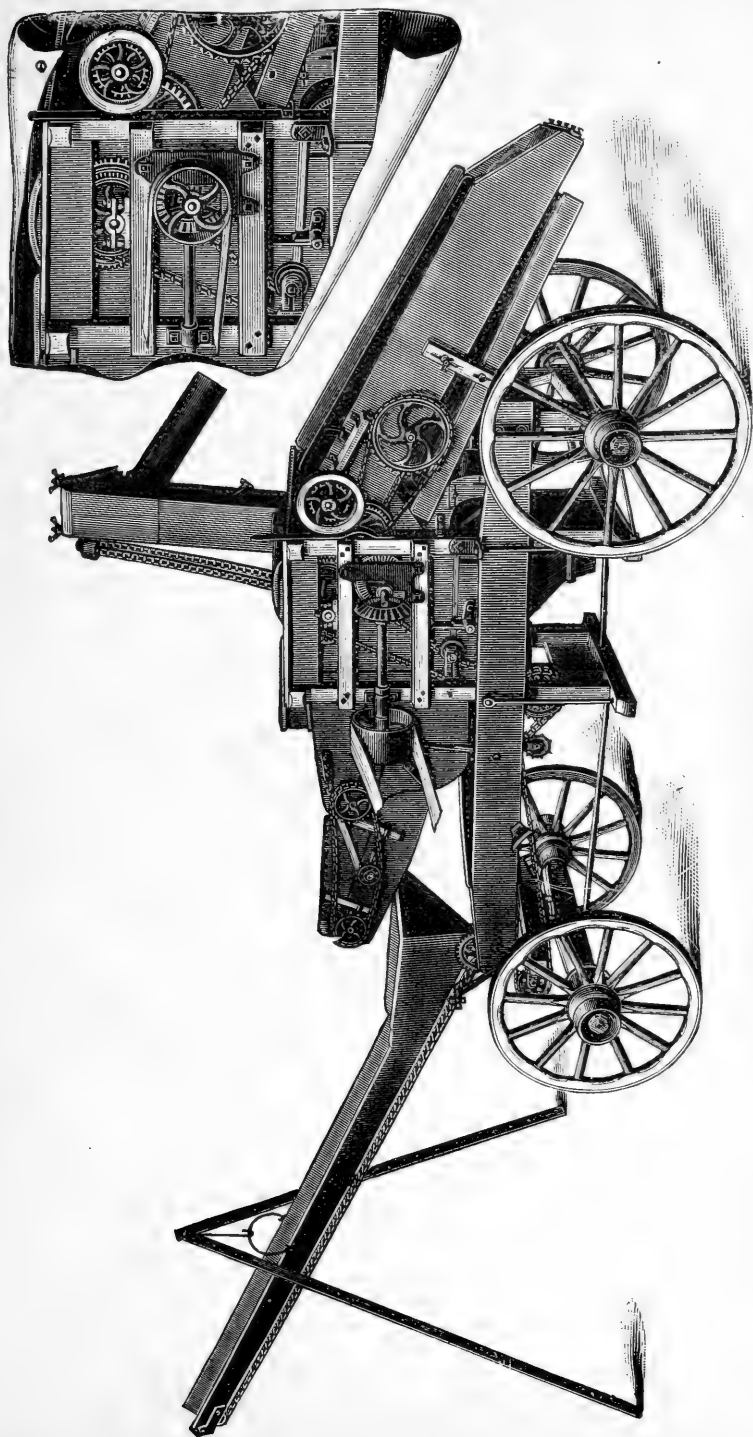
While these new implements, and many others we have not the space to mention, have been developed, walking plows have not been forgotten, and as complete a variety of wood and steel beam plows as the farmers of the west require is made at Dixon, the list comprising over 100 styles, which would necessarily require a volume to describe or illustrate.

Sandwich, Ill.

THE SANDWICH MANUFACTURING COMPANY.

WHEN the late Augustus Adams started his little foundry at Elgin, Ill., in 1840, it was, so far as known, the only one in existence west of the Great Lakes. A small one had been projected in Chicago a year or two before, but could not be maintained, and had gone down. The first lot of Lehigh, or hard coal, brought to Chicago, was on an order from him executed by a Chicago commission house. In this way began the career in the west of a pioneer inventor and manufacturer, who is entitled to the first rank among the benefactors "by whose lives and genius many are made wealthy and enjoy greater immunity from the labor and drudgery of past ages; and who have conduced to make business a pleasure in these modern times." His career as a manufacturer for more than sixty years, during fifty of which he was identified with the manufacturing industries of Illinois, was prominent. Simultaneously with the mention of his name are called to mind many of the more important inventions of which he is the father, and for which the great west is indebted to him; prominent among which may be listed the first grain-cutting machine on which the grain was bound and carried together; the "hinged bar," now used in mowing machines of all classes, and towering above all, the celebrated Adams self-feeding power corn-sheller, which, with improvements made by himself and his sons in following years, have made the names "Adams" and "Sandwich" household words wherever corn is raised expressive of the highest excellence in corn-shelling machinery.

Many curious incidents were connected with Mr. Adams' beginning as a manufacturer. The first iron he melted was in a little "pocket furnace," or rudely constructed brick melting pot, and with charcoal burned by himself for the purpose. The iron came from a small pile that remained in Chicago, on the site of the older undertaking above referred to, that had run for a short time and gone down; and the first castings that Mr. Adams made were what the Hoosiers, who came long distances to buy them, called "sled soles" and "plow pints." Seeking to improve upon this first crude beginning, he undertook unaided the construction of a melting apparatus somewhat more in the nature of the modern cupola, and believed he could melt to better advantage by the use of Lehigh, or the hard Pennsylvania coal, than by charcoal, if he could procure it. There was no stock in Chicago, and so far as he knew, never had been any brought up the lakes, and he encountered some difficulty in getting the small amount he required to make the experiment. His limited means would not admit of any investment in that stock beyond what was required for such an experiment, until



THE SANDWICH FOUR AND SIX HOLE MOUNTED BELT SHELLERS.

it could be shown that it would be available for further operations. He succeeded in interesting the shipping house, Norton & Grey, of Chicago, to forward an order for him to Buffalo or Erie for a small amount, say a few hundred pounds, to enable him to carry out his undertaking to that extent. It was well understood that the time required to get the stock around to Chicago on such an order would be greater than would be required now to order and receive goods from England. After the lapse of something more than two months, he was notified by the house Norton & Grey that the order had been executed, and the coal was on the way, but by some mistake of the shippers a larger amount had been sent than he ordered, in fact about a ton, which was contained in three hogsheads, and as they had no call for that stock, and did not see any immediate prospect of disposing of the surplus, they had to ask him to take the whole lot, which he did. The incident was one that pioneers in the coal trade in Chicago often referred to afterwards as the beginning of an enormous traffic, which at the present time requires several miles of docks on the Chicago river.

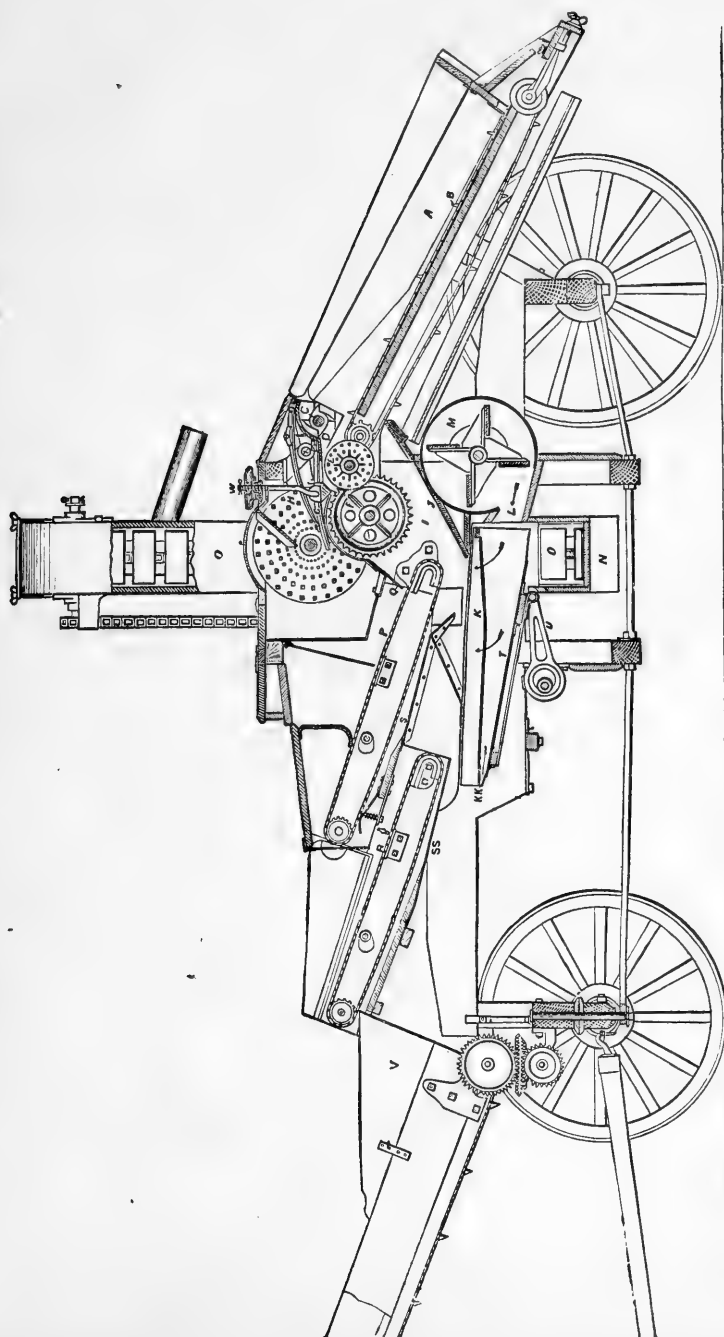
Mr. Adams at a very early date became convinced that the corn crop was destined to be the most important of the agricultural products of the Mississippi valley, and that great wealth and traffic would develop in the raising and shipping of that grain. Elgin was then one of the few growing towns of northern Illinois, and a few years after came into prominence as the temporary terminus of the first railroad out from Chicago, then known as the Chicago & Galena Union, and which is now a part of the Chicago & Northwestern system. Like most other pioneers, Mr. Adams suffered considerable loss in the development of his machinery. He was then serving in the state senate and came into acquaintance with parties from Sandwich, who succeeded in interesting him to remove his family and business from Elgin and locate in this then new town, the principal inducement thereto being that Sandwich would be nearer the center of the corn belt, and was advantageously located on the Chicago, Burlington & Quincy road, which had been recently completed through to the Mississippi river.

Removal was made in 1857, and business begun there under the firm name of A. Adams & Sons. The venture proved successful. The small shop established grew as the demand increased throughout the west, and a large trade was developed, especially during the war. By 1867 the business controlled by the firm had become so great in its extent that incorporation was deemed advisable, and the Sandwich Manufacturing Company was organized to succeed to the firm of A. Adams & Sons.

Mr. Adams did not remain long in active connection with the company after incorporation. Early in the "seventies" he withdrew and interested himself with his younger sons in founding and developing another manufacturing business at Marseilles, Ill., which has come to strong standing and an enviable reputation.

For many years before his death, which occurred in October, 1892, he had practically retired from all business.

Since the incorporation of the Sandwich Manufacturing Company it has been under the immediate direction of J. P. and H. A. Adams (the oldest sons and members of the original firm of Adams & Sons), to whose ability as business men, manufacturers and inventors, the success of this, one of the



SECTIONAL VIEW OF THE SANDWICH POWER SHELLER.

oldest and best known manufacturing houses of the interior, and its world famed power corn shellers, may be ascribed.

The business has since kept step with the development of the interior and western states in the production of corn, and the Sandwich shellers have come into use all through the country. While power corn-shellers are not so generally used in the eastern states as in the Mississippi valley and westward, still the operations of the house are important east to the Atlantic seaboard, and their machines have an export sale of growing volume from year to year.

From the two-hole corn sheller, fed by hand, with which manufacture begun in the early years, has been developed the powerful self-feeding machines of the present day, made in such sizes as the smallest farm product, or the greatest holdings of the heaviest corn buyers may require, machines with a capacity to take from the crib and deliver in perfect merchantable condition into warehouses or cars anywhere between five hundred and five thousand bushels per day. The factory has grown from the small wooden shop first established, and though twice burned down, has each time come up with still greater capacity for manufacturing, until to-day it ranks among the largest institutions in the west.

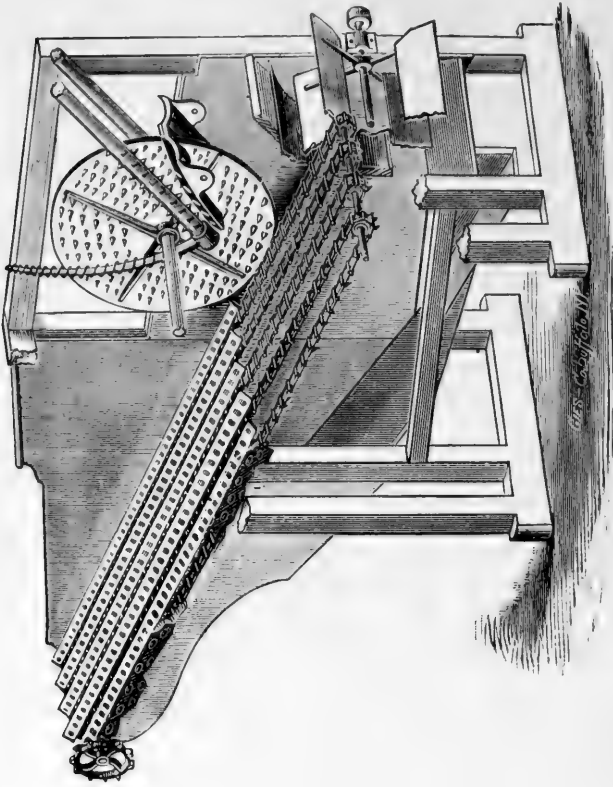
Sterling, Ill.

THE PIONEER WORK OF THE KEYSTONE MANUFACTURING COMPANY.

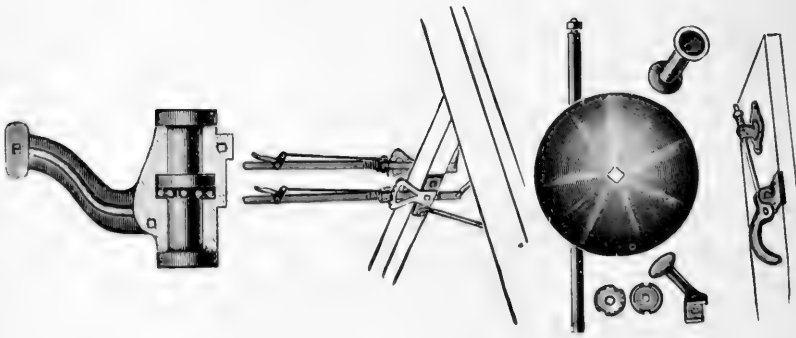
"THERE be three things," said Bacon, "that make a nation great and prosperous; a fertile soil, busy workshops, and easy conveyance for men and goods from place to place." After the lapse of nearly three centuries, during which the civilized nations of the world have made greater progress than the most optimistic dreamer of Bacon's time could have predicted, the force of the philosopher's maxim can be understood, especially by Americans. A soil of inexhaustible fertility, mammoth workshops and factories to furnish the farmer improved implements and machinery for carrying on his work, and a network of steel highways traversed by the "iron horse," have contributed to the building up in the Mississippi Valley of a vast empire, the wealthiest, most powerful and most enterprising in the world. How much of the progress the west has made in the last half century is due to the resources of the soil and the industry of the pioneer settlers, and how much to the inspiration of inventors, who have produced the labor-saving implements necessary to develop those resources, no one can measure, but certain it is that the inventors and pioneer manufacturers who have produced these marvelously ingenious implements have erected to themselves monuments more enduring than marble or granite in the records they have made in the development of this country.

Of the pioneer manufacturers who began prior to 1860, only one is left in active charge of the business he established. Thomas A. Galt, president of the Keystone Manufacturing Company, of Sterling, Ill., enjoys this distinction. Mr. Galt began manufacturing at Sterling in 1857. He was a Pennsylvania boy, born in 1828, brought up on the farm with meager opportunities for an education, and thrown upon his own resources at the early age of fourteen by the death of his father. After working several years in a store as a clerk at Concord, Pa., at Strasburg and Philadelphia, he began business for himself at Strasburg, but sold out in 1855 and came west to Sterling. Here he opened up in the hardware business, in which he continued several years.

In 1857 Mr. Galt started a small 14x16 shop to manufacture broadcast seeders. Only two men were employed at first, but the business grew rapidly, not only in the manufacture of seeders, but in other lines that were added soon after. Mr. Galt's was one of the first seeders put on the market. In 1863 he began the manufacture of hand corn-shellers, and also of cultivators and wagons. About this time Mr. Galt formed a partnership with Geo. S. Tracy, who had been conducting a planing mill, and the two lines of business were consolidated under the name of Galt & Tracy. The facilities of the new firm for manufacturing implements were considerably increased,



THE SHELLING AND SEPARATING DEVICES OF THE KEYSTONE SHELLER.



PARTS OF THE KEYSTONE DISK HARROW.

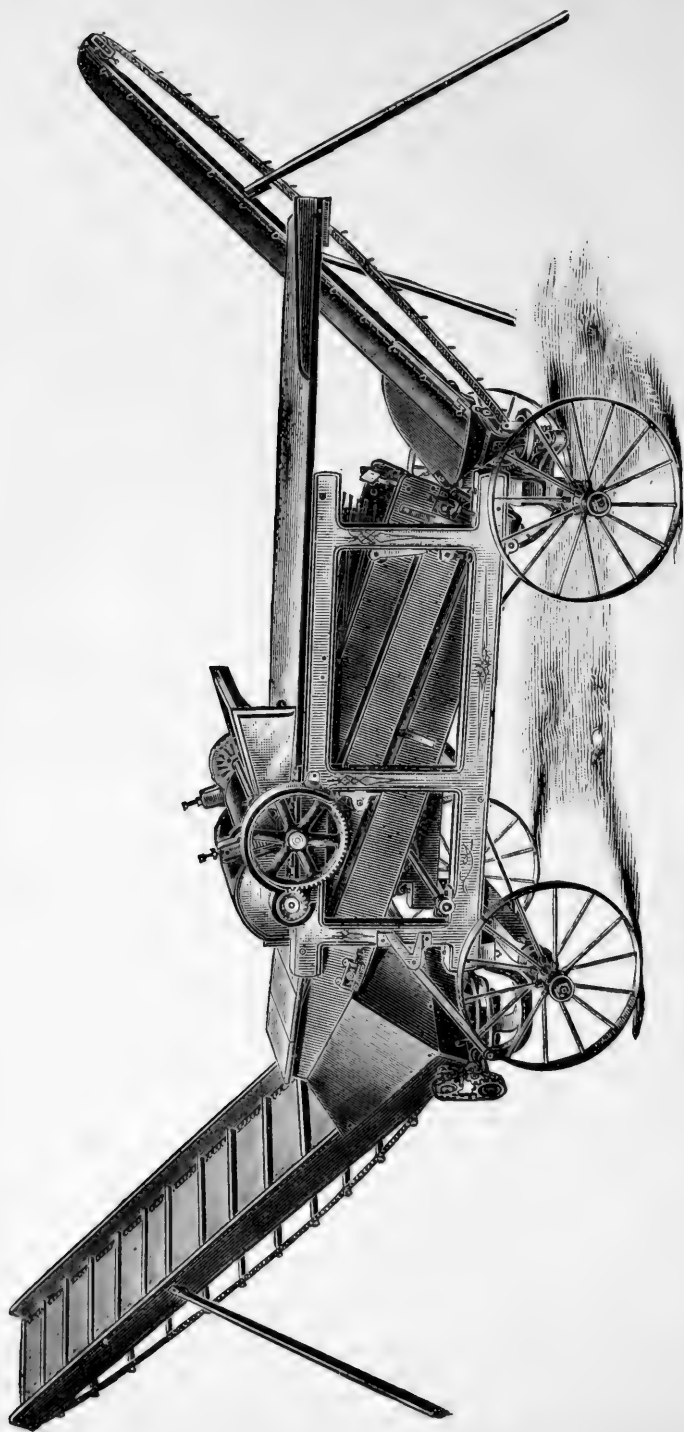
and corn-shellers were put out in large numbers, as well as broadcast seeders and various other implements.

The Keystone Manufacturing Company have been among the very largest manufacturers of corn-planters, beginning at a very early day, in 1867. In fact the name Keystone was derived, at the time of incorporation, from the Keystone planter, which had been introduced in the trade by Galt & Tracy. It was made on the "open heel" drop pattern, and was an excellent implement. The prestige gained by its introduction at the time when the west needed it most has been well maintained by the company, who have contributed many improvements and are to-day in the front rank. By this time their factory was one of the largest in the west, as a result of improvements which they had contributed to the various lines in which they were engaged. The west was developing rapidly, and their business under the best of management, was more than keeping pace with it. Sterling had become one of the foremost manufacturing cities in the west, and implements made at Sterling were in use wherever corn was grown.

About this time the Keystone hay-loader was brought out, and the company undertook the pioneer work of its development and introduction. The work of loading hay in the field was the most tedious in the harvesting of this important crop, and the improved mowers and rakes that had been developed made it seem still more laborious and awkward. The Keystone loader was destined to play no small part in expediting the hay harvest, in which time is a more important factor than in any other work done on the farm. This valuable implement is illustrated in the chapter on haying tools and machinery.

In 1874 the Keystone power corn-sheller was brought out. It was made under the Packer patents, covering an entirely new principle in this class of machinery, the purpose of which was to give large capacity and perfect separation. As shown in the illustration of this shelling principle the shelling picker wheel has been discarded in it, and a "picker shaft" has been substituted for it, with a shelling length of nine inches, this shaft passing the corn through rapidly and insuring perfect shelling. The shaft is adjustable for damp or dry corn by the thumbscrew above, the lower end being free to move up or down under pressure, regulated by the coiled spring above it. In the Keystone sheller the corn is separated from the cobs by an open-link carrier on which it falls, the links being large enough to allow the kernels to pass through, but retaining and carrying over the cobs with the silk and bits of husks that would otherwise fall in the shelled corn.

It is, however, in the development of the Keystone corn-husker and fodder-shredder that Mr. Galt has shown in the highest degree the originality and foresight of the true pioneer. This machine is without doubt destined to hold the highest place in the near future, in the labor-saving equipment of the corn-growing farmer, for it not only saves labor but in a large part of the west will double the value of the corn crop. The chemist and the practical stock feeder alike agree that the ears of corn contain only a little more than half of the feeding value of the plant, but heretofore the farmers of the west have been unable to save their fodder, this part of the crop going generally to waste, except as cattle may be turned into the fields after husking to



THE KEYSTONE CORN HUSKER AND FODDER SHREDDER.

feed upon what they do not tramp under foot. The Keystone corn-husker and fodder-cutter is destined to revolutionize corn-growing in the west, by making it possible for the farmers to save their fodder and make the best kind of provender of it, a feed, in fact, that commands when baled as high a price in our city markets as hay. Incidentally the machine saves the husks separate from the fodder, and for them there is a demand that would pay for the machine itself, in some cases, in a season's work. The fodder is either shredded by the cylinder mounted in front of the feed rollers, resembling a thresher cylinder, or it may be cut by a cylinder mounted with knives like those of a feed-cutter.

The Keystone Manufacturing Company are also the pioneers in the manufacture of disk harrows in the west, they having begun in this line in 1880. Improvements have been contributed by them from time to time, and a very large business has been built up, sales in a favorable season amounting to 10,000 harrows. An important improvement which they have made is in adopting ball bearings to carry the end thrust of the gangs.

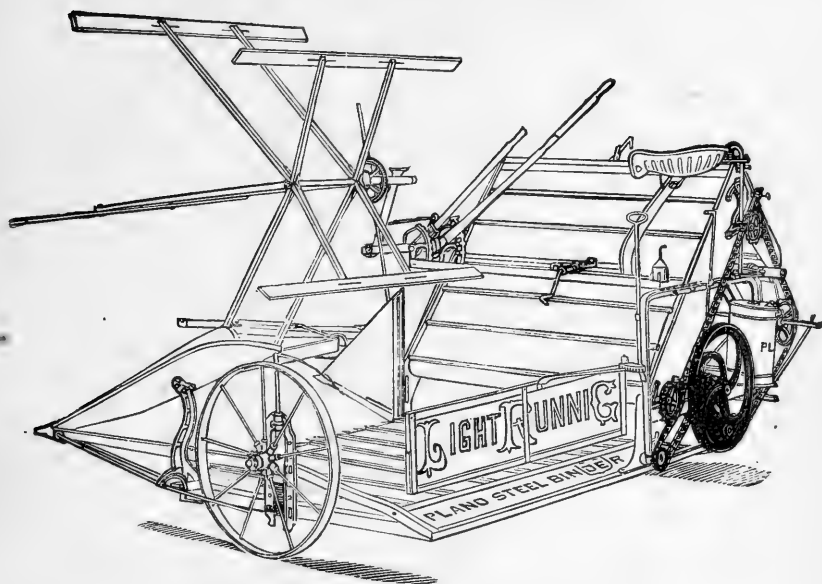
Plano, Ill.

THE PIONEER "HARVESTER CITY."

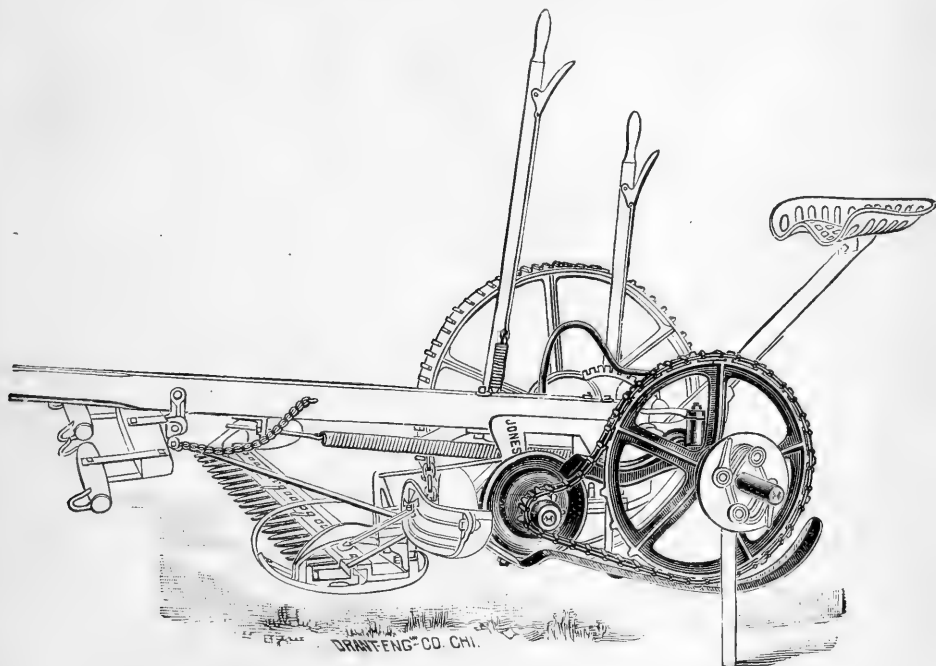
"BOYS, you are on the right track. If you can run your machine successfully ten rods it can be made to run ten miles, and there is a man at Plano who can make it do this." These encouraging words spoken to the Marsh brothers, in the harvest of 1860, by Lewis Steward, made Plano the pioneer city in the manufacture of modern harvesting machinery.

The first Marsh harvester was built in June, 1858, and although it was rudely constructed it worked successfully through the harvest of that year. The practicability of the principles embodied in the machine was demonstrated, but the inventors were far from being skilled mechanics, and their efforts in 1859 and 1860 had resulted in the break down of their experimental machine, witnessed by Mr. Steward. That the inventors were discouraged may be readily understood. They had been unsuccessful in getting manufacturers interested in the machine, and situated as they were, many miles from the railroad, the prospects for getting it established on the market were dubious indeed.

The encouraging advice of Mr. Steward led to the building of an experimental harvester at Plano, for the harvest of 1861, and this was used and tested under varying conditions, until 1863, when the machine was considered "sufficiently developed for the test of sale." For the harvest of 1864, the firm of Steward & Marsh made and put out twenty-six machines, the first harvesters ever put upon the market, and thus the foundation was laid for the harvester business at Plano, and for the manufacture of harvesters and binders for the market of the world. The firm of Easter & Gammon were at this time engaged at Chicago as dealers in reapers and mowers. They met this first lot of harvesters in competition in the field, and soon after, in 1864, they obtained exclusive rights for the sale of the Marsh harvester for six western states. This arrangement was continued until 1868, when Easter & Gammon dissolved partnership and divided between them the territory they held under the Marsh patents. Mr. Gammon then took James P. Prindle into partnership, and the firm of Gammon & Prindle continued the business. In 1869, Mr. Gammon acquired an interest in the Plano shops, with the Marshes and Stewards, and early in 1870, Mr. Prindle having retired, William Deering took an active interest in the institution, and the afterwards famous firm of Gammon & Deering was organized, becoming in time sole owners of the Plano shops, and gradually enlarging the sales of harvesters and automatic wire binders; the firm of J. D. Easter & Co. having failed in 1877, and turned over their territory under the Marsh patents to Gammon & Deering. In the fall of 1879 Gam-



THE PLANO BINDER, WITH FLY WHEEL, ATTACHED.



THE CHAIN DRIVE OF THE JONES MOWER.

mon & Deering dissolved partnership, and the business of the firm was removed to Chicago and continued by Mr. Deering, whose remarkably successful career since that time is told elsewhere.

THE PLANO MANUFACTURING COMPANY.

During the winter of 1880-81 the works at Plano were idle, but in April, 1881, steps were taken to organize a company, with a view to carrying on the manufacture of twine binders, in the town that had acquitted itself so well during the development of the industry. William H. Jones took the lead in the new enterprise, Mr. Gammon and Lewis Steward promptly coming to his support. Mr. Jones was well qualified for the difficult task of launching the new business. He had begun in 1866 in the sale of reapers and mowers, in Wisconsin, and had been identified with the Plano interests since 1870, at which time he entered the employ of Mr. Gammon. Until Gammon & Deering dissolved he served in the capacity of superintendent of agencies, remaining with Mr. Deering until 1881, when the Plano Manufacturing Company was incorporated, with Mr. Jones as president and executive officer. The old shops had suffered from business changes, and were so fire-scarred and dismantled when the new organization took possession that only 250 binders could be manufactured for the harvest of 1881, but so well acquainted was the new organization with every detail of the business, and with the mechanical construction required to make a perfect harvester, that these machines were eminently successful, and ten times the number were put out the next year. From this beginning the business grew rapidly, and to-day the Plano Manufacturing Company rank among the very largest manufacturers of twine-binding harvesters.

Several features distinguish the Plano "light running" binder from the standard Appleby machines. A peculiar style of chain drive has been adopted, which contains many meritorious features. In the reel a radical improvement has been made in adapting to it a friction clutch that allows the reel to turn back when it meets an obstruction in the grain or overhead, thus avoiding breakage. Most important of all, however, is the application of stored power, obtained through the use of a "fly wheel." In the best adjusted binders in the hands of an expert there is a slight variation in the draft of the machine at the moment of tying a bundle, and in the average machine in the farmer's hands, the difference in draft at this point is quite appreciable.

In their mowers the Plano Manufacturing Company have "pioneered" or introduced in the trade, the chain-drive principle, the advantage of which is that wear does not impair its efficiency, or cause loss of power. As the sprockets do not require as perfect alignment as gears, they therefore run more freely and are less liable to get out of order. The great problem in agricultural machinery is to perfect devices that give a high rate of efficiency when new, and at the same time are not easily deranged by abuse or neglect on the part of the operator, or by the wear of two or three seasons.

These and other distinctive features of the Plano machines are the result of a lifetime spent in the field by the president, Mr. Jones, who was one of

the pioneers in the introduction of the Marsh harvester. His life, in fact, from field expert and canvasser to president, would make as romantic a story as could be found in the machine trade. As Mr. Marsh has observed: "Probably no one knew as well as he what were the essentials of a thoroughly satisfactory harvesting machine to run in the field. Mechanics, no matter how skillful or sensible, consider a machine always from a mechanical point of view, and even if they have had much field experience, their shop training will govern, and they are ever inclined to sacrifice operative qualities to mechanical construction when these points seem to interfere. To thoroughly combine and fuse these attributes into one machine required the master hand and strong will of Mr. Jones. In the construction of the original Plano harvester and binder, he made practical operative qualities paramount, and mechanical science subservient to their production; and he ruled out peremptorily every device or suggestion that did not have, in his opinion, that end in view. This course he has maintained right along, and its result is manifest in the excellence of the Plano machines and the phenomenal success of the Plano Manufacturing Company."

We may here leave to some future historian of the agricultural implement industry, the sad duty of writing the last chapter in the history of Plano. With a record of thirty years, beginning with the pioneer work of introducing the Marsh harvester, Plano has yielded the scepter to Chicago, and will be known no more in the manufacture of harvesting machinery. Within the past year the Plano Manufacturing Company has erected at West Pullman, a suburb of Chicago, one of the most labor-saving and completely equipped for the manufacture of Plano machines, more than doubling its facilities and has abandoned the Plano shops, thus ending the career in this industry of the town which has earned the laurel of "Harvester City."

South Bend, Ind.

THE OLIVER CHILLED PLOW WORKS.

THE world is ever ready to do honor to men who have been successful in war, or in political or professional life, but it seems to give credit grudgingly or not at all to those who in practical pursuits, by power of mind over their surroundings, have conceived inventions that affect the destiny of nations. The one who directs an army and destroys life and property is idolized, but the inventor who adds to the wealth of the world by increasing man's power of production, and who lengthens the life of the farmer by lightening his toil, is too often destined to be forgotten. How few there are to-day, for example, who are familiar with the names of Chas. Newbold and Jethro Wood, the inventors who conceived and made practical the cast-iron plow.

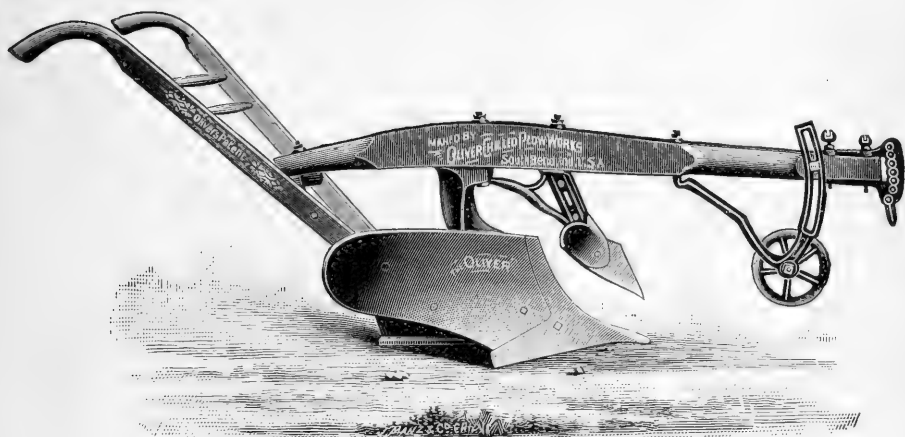
As soon as the farmer of fifty years ago had been taught to use something better than his old wooden "bull" plow, he turned his attention to labor-saving problems in other lines of farm work, and the reaper, the threshing machine, the mower and other modern implements were brought forth in due season. The cast-iron plow awoke the farmer from his lethargy of eighteenth century methods, but as the country became settled, conditions arose that it could not master. The soil in which it had at first worked satisfactorily, became, by repeated stirring, dense and sticky, so cast-iron would not scour; and it was also found that many kinds of soil could not be plowed with it at all. Besides, the farmers had become more ambitious, led on by widening markets for their crops, and would wear out a plow in one season that under the old conditions might have lasted ten.

The invention of the chilled plow by James Oliver, of South Bend, Ind., was destined to revolutionize the cast plow industry and furnish the farmer, at a moderate price, a plow with a mouldboard that would scour in any soil and last a lifetime. Mr. Oliver spent years in experimenting with chilled metal and succeeded eventually in making a perfect chilled mouldboard. This was his greatest achievement, but it was for him only the stepping-stone to other inventions that revolutionized the construction and adjustment of walking plows, constituting as a whole a series of inventions that can scarcely be paralleled in the record of any inventor of agricultural implements. Furthermore, Mr. Oliver has been an eminently successful business man, and the Oliver Chilled Plow Works have grown under his supervision until they rank not lower than fifth or sixth, in the number of men employed and the value of the annual output, among the agricultural implement factories of the world.

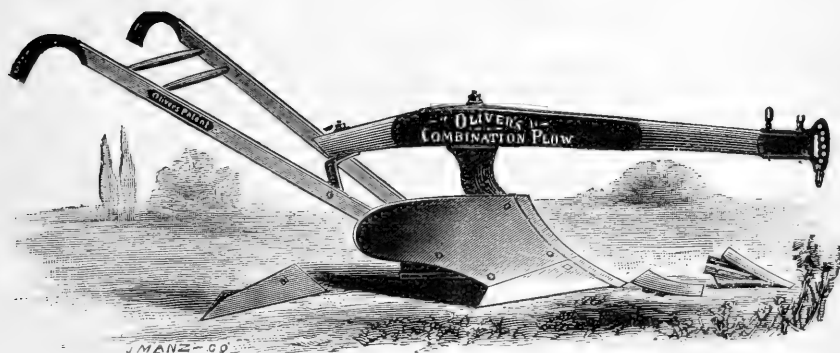
The manufacture of plows was begun in South Bend, in 1855, by Mr. Oliver, he having previously worked for some years as a moulder, executing in that time difficult contracts for making castings. There was little in the



THE OLIVER CHILLED PLOW.



THE OLIVER CHILLED PLOW WITH WHEEL AND JOINTER.



THE OLIVER CHILLED PLOW WITH REVERSIBLE POINT AND SHARE.

beginning that was suggestive of the present Oliver Chilled Plow Works. The shop was a small one and uninviting in appearance, and the casts run but three heats a week, with 1,500 pounds to a ton each. Yet even at this rate the capital of Mr. Oliver and his partner was soon exhausted, and they were in straightened circumstances, when an unexpected misfortune visited them in the form of a tremendous freshet that flooded their furnace. After recovering from this misfortune, Mr. Oliver bought a team and wagon and began a canvass of the country to get his plows introduced. He found it uphill work, but persevered until he had eighty agencies established within a radius of fifty miles. This seemed like a fair beginning, but the difference between the cost of production and the price obtained, after deducting commissions and the expenses of selling, left a very narrow margin of profit. However, a substantial foundation was laid upon which to build and extend the business in the future.

It was about this time that Mr. Oliver began to investigate the possibilities of a plow that would scour in all kinds of soil and at the same time be more durable, especially in sandy or gravelly land. Naturally his thoughts turned to the use of chilled metal, but the prospects of success in this direction were poor indeed. Fortunes had been spent in the preceding twenty-five years in experiments looking to a perfect chilled plow, and those who had once been sanguine had given up all hope. "Nothing daunted," said Mr. Oliver in an interview a few years later, "I determined to solve the mystery. When I announced my determination people held up their hands in admonitory horror, and regarded me with feelings of astonishment, not unmingled with contempt, which latter they were free to express. Plow men who had spent years in experimenting and had abandoned the project of a complete chilled plow advised me not to undertake it. Those who had aided me with money and influence forsook me, and I was classed with the fools who pursue the fallacy of perpetual motion. Although feeling keenly the cuts of former friends, I determined to succeed. Day and night for years I thought of nothing else, and made everything bend to this one great object of my life. My first success was attained when I adopted the plan of using hot water in the chills, which dried the moisture in the flasks and prevented blow holes. My next was a method of ventilating the chills by grooves along the face of the mould, which allowed the escape of the gases that form within the flask when melted iron is poured in, and thus permitted the liquid metal to come in direct contact with the face of the chill and all its surface, removing all the soft spots in the mouldboard and leaving the surface smooth and perfect. But my crowning success was the discovery of the annealing process, which deprived the metal of its brittleness. When I made that I could justly claim that for the first time a fully perfect chilled plow had been made."

As may be seen by reference to the chapter on plows, Mr. Oliver's inventions cover a number of important features in a walking plow. These are the slotted handle-brace for holding the heel of the beam, so it can be set for two or three horses; the peculiar form of standard by which the beam is given a "center draft" position; the share with a coulter or cutting edge seated directly against the front end of the mouldboard, thus giving a new cutting edge each time the share is renewed; the wheel for a wood beam

plow having a standard that can be adjusted closely to the line of draft when the beam is shifted, and the bracket that holds the coulter or share to the beam by the use of only one bolt. The farmer who will compare the work of the Oliver plow with one that does not possess these features can understand how much they add to its efficiency. These improvements explain the enormous business of the Oliver Chilled Plow Works. It has been but the natural course of the "trade" concentrating upon South Bend a demand for plows that has built up a factory covering a good sized farm, with an enormous foundry and a blacksmith shop, wood shops and other departments of proportionate size. On this "farm" a thousand men find employment and support as many families, and from it goes forth to all parts of the Union, and to every foreign country, the American chilled plow, emblematic of American ingenuity and skilled workmanship.

Associated with Mr. Oliver in the first years of his business was Harvey Little and later T. M. Bissell and George Milburn. His partners withdrew in time, however, leaving Mr. Oliver as the principal owner of the South Bend Iron Works, the business having been incorporated under this name. Mr. Oliver is now president of the corporation, his son, Joseph D. Oliver, treasurer, and George Ford, secretary. Branch houses have been established in the leading trade centers, where the Oliver goods are carried in stock and distributed under the direction of veteran plow men, some of whom were with Mr. Oliver during the early years of the industry. St. Louis, Mo., Indianapolis, Ind., Mansfield, Ohio, Harrisburgh, Pa., Rochester, N. Y., Dallas, Texas, and San Francisco, Cal., are the most important of these houses.

PIONEER THRESHER FACTORIES AT RICHMOND.

The Robinson Machine Works were established at Richmond, Ind., in 1842, in the manufacture of "chaff-piler" threshing-machines. A traveling thresher, designed to thresh the grain as it was drawn through the field, was also made for a time, neither of these machines separating the grain from the chaff. About 1860 they commenced making portable engines and Pitts separators. In 1872 the business was incorporated under the name of the Robinson Machine Works, and in 1889 they reincorporated as Robinson & Co., with F. W. Robinson as president and superintendent; A. G. Robinson, vice-president and treasurer, and S. E. Swayne, secretary.

The business of Gaar, Scott & Co. was established at Richmond, Ind., in 1835, by J. M. and J. Hutton, who continued until 1849, when A. Gaar & Co. bought them out. The latter firm was incorporated in 1870, under the name Gaar, Scott & Co. The manufacture of portable engines was begun in 1852, and traction engines in 1878.

THE HOOSIER GRAIN DRILL.

The manufacture of the Hoosier grain drill was commenced at Milton, Ind., in 1857, in a small way by the patentee, Joseph Ingels. In 1868 the business was purchased by the Hoosier Drill Company. In 1870 the manufacture of corn drills was begun, and broadcast seeders in 1877, and in 1878 the company removed to Richmond, where new works were erected. Many changes have taken place in the ownership and management of the business. J. M. Westcott is now president; Omar Hollingsworth, treasurer; B. J. Westcott, secretary, and J. A. Carr, superintendent.

Akron, O.

AULTMAN, MILLER & CO. AND THE BUCKEYE MOWER.

IN accrediting any house with pioneer work in the industry with which it has been identified, it is implied that some improvement of far-reaching importance has been contributed by that house, or that a revolution has taken place in the industry as a result of a new principle it has evolved. In some cases a pioneer invention merely substitutes new devices for old without materially increasing the usefulness of the implement or machine, but in every industry there has been contributed at some stage of its development an invention that entirely changes the "standard" and so increases the usefulness of the machine that the result appears at once in the changes that follow in the area and yield of the crop or crops for which it is adapted. In the case of the revolution that followed the invention of the hinged-bar principle in mowers (as embodied in the Buckeye) this change appears in a striking manner.

For example, the annual hay crop for ten years prior to 1856, the date of the invention of the Buckeye, averaged less than 11,000,000 tons. For the ten succeeding years it exceeded 26,000,000 tons. This prodigious increase, more than doubling the crop production, cannot be attributed to the growth of population. Compared with the rate of increased crop product, that growth was so small as to be almost insignificant. As a matter of fact this enormous stimulant to the production of the hay crop was due to the invention of the two-wheeled hinged-bar principle of the Buckeye, and to the general introduction of mowers and reapers embodying that principle.

An event partaking somewhat of the dramatic in character indicates the incipency of this harvester revolution with singular clearness. The United States Agricultural Society invited a general field competition of harvesting machines at Syracuse, N. Y., in July, 1857. Every machine made in the country participated in the trial, the record of which, with cuts of the machines, is preserved in the report of the judges. Every machine present except the Buckeye, whether mower or reaper, had one driving wheel. These machines had no hinged-bars; their driving gears were on, or inside of the driver, and not on the axle; this gear did not cease to impart motion to the cutting parts when the machine moved backwards; they had no leading wheels with brace to coupling-arms; they had no adjustable track-clearers; they had no shoe-slides, and guards with steel-faced cutting edges; their cutter-bars could not be lifted, neither could they be folded, nor had they any foot-lifting device.

The machine which was destined to endow agriculture with all these advantages, advantages which have "finally been adopted by the public and

the world," and which, for all that is now known, "will forever afterward become a part of the perfect machine," was the Buckeye.

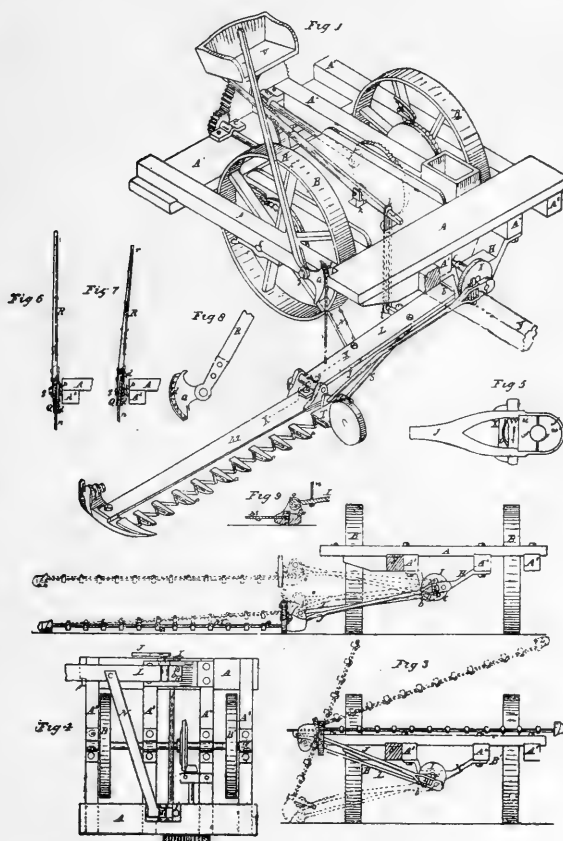
The Buckeye was also at Syracuse, putting in its first public appearance on that occasion. Although made first as a mower, its motive system was

L. Miller.

Mower

N^o 759

Reissued Jul. 9. 1859.



THE "HINGED BAR" IN DETAIL.

immediately adapted to reaping. The larger portion of the grain and substantially all the grass of the world was harvested by machines modeled on the Buckeye system until the advent of self-binders furnished a speedier method for grain.

The starting point, in a manufacturing way, of the Buckeye industry was made at the village of Greentown, Stark county, Ohio, in the early "thirties." John Miller, the father, and Lewis and Jacob Miller, the sons, also C. Aultman and Ephraim Ball, were interested in the shop which turned out plows, harrows, spinning wheels and threshers. Later on, about 1848, Hussey reapers were made under a royalty.

Still later it was decided to add a mower to the output. Negotiations were entered into with Mr. Ketchum, the patentee of the most successful mower of that day. Mr. Ketchum fixed his royalty at \$40 per machine, and was inexorable. The young firm decided that such a figure was inadmissible, and resolved to make a mower of their own invention. That was a turning point. Had the price fixed by Ketchum been satisfactory, those revolutionary modifications which are classed under the general term of the "hinged-bar" might never have been made.

After the above action had been taken by the firm there ensued a series of experiments and trials, the full details of which would make, if space permitted, a wonderfully interesting chapter in pioneer harvester history. Lewis Miller, who led the way in these inventions, is still living, and it was from him that these particulars were obtained.

The first experiment ended with the machine here shown, the first successful two-wheeled mower. It did good work and its inventor was very proud of it, so much so that he had this cut made. Its gears, however, were in the drivers, and it had a stiff bar. It was resolved to change that.

This brings us to the second experiment, which also ended satisfactorily, so much so that a patent was applied for. An

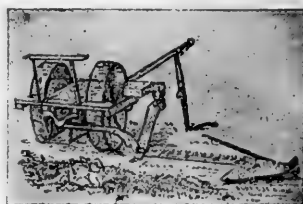


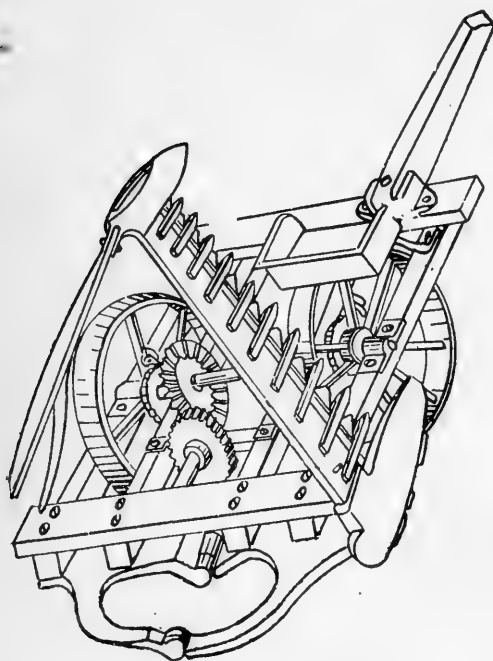
illustration is shown of the drawing that was used. The gears had now been transferred to the axle and the bar made pliable by hinges. Not until a considerable time after this stage of development had been reached was it learned that Sylla & Adams, of Illinois, had already patented a device which involved this principle of a hinge in the bar. Though very unlike the Buckeye plan, and used for a different purpose, it still involved the principle. The exclusive right to its use was bought for a modest sum.

The third and last effort that can be called an experiment ended in 1857, culminating in the machine shown at Syracuse. The period covered by this evolution reached from 1854 to 1857. It was, as has been intimated, a period of severest tension, and the problem was only wrought out by the help of a stout heart and an unbounded faith. The story in detail, like many another story of great efforts crowned by grand successes, will never fail to win for its heroes the profoundest respect and the highest admiration.

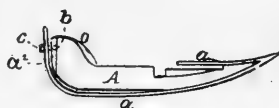
The principles embodied in this machine, generally known under the term "Buckeye," are shown in a drawing filed with the patent of July 9, 1859. This illustrates more clearly than a shaded machine picture can do some of the special, and now indispensable, devices to which reference has just been made. The folding of the bar as shown is still peculiar to the Buckeye,

although the latter first taught the lesson of folding the bar in any shape.

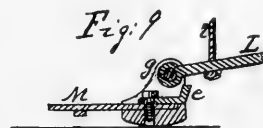
In addition to that feature may be seen the brace *N*, the wheel *C*, with its brace *S*, the lifting lever and quadrant shown by figures 6, 7 and 8, the *adjustable* seat *V*, the foot-lift *P*, all of which, as much as the two wheels, have been derived from the Buckeye and constitute part of the "perfect machine" of to-day. Another device, and an indispensably important device to every modern mower, is the knuckle-joint, with gag *e*, as shown in the small cut. Another of the Buckeye devices in general use on mowers is the "adjustable sole," of double-runner form, shown in cut. The



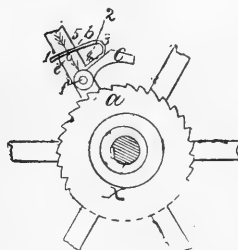
THE SECOND BUCKEYE EXPERIMENT.



THE ADJUSTABLE SOLE



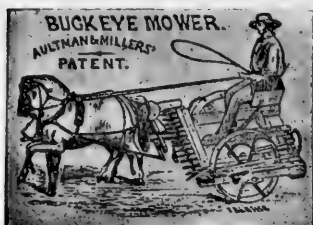
THE HINGED BAR "KNUCKLE."



THE PAWL AND SPRING.

pawl, with spring, transmitting the motion of the drive-wheels to the cutters while moving forward, but not backward, is invaluable and indispensable on all mowers.

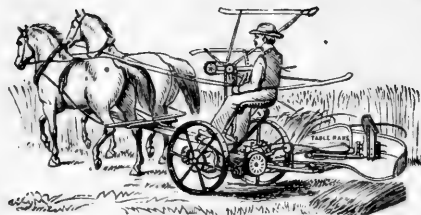
In the foregoing, reference has been had only to the pioneer days of a pioneer industry; in other words to those successive mechanical achievements by means of which one of our great industrial establishments entitled itself to the honor and gratitude of mankind. Space forbids farther venture in this history than a most summary outline. All manufacturers were compelled to immediately avail themselves of the Buckeye inventions. Serious objection was made only by several houses, now mostly extinct, to the front-



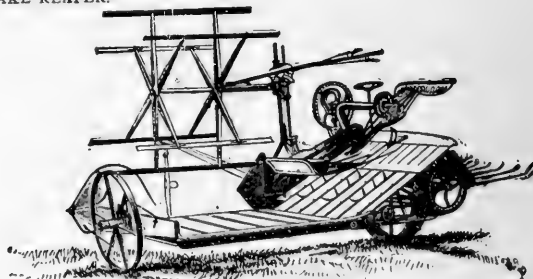
THE "ORIGINAL" BUCKEYE.



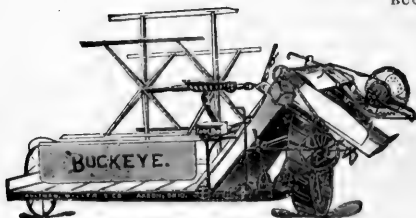
BUCKEYE MOWER OF TO-DAY.



BUCKEYE TABLE RAKE REAPER.



BUCKEYE BANNER BINDER.



BUCKEYE "FRAMELESS" BINDER.

cut, but its **greater** safety in connection with other advantages, made it invincible.

During the era of the reaper, extending from 1856 to 1880, the Buckeye works were large makers of that class of machines. The great bulk of the reapers bearing the brand Buckeye were of the Table-rake pattern. The peculiarity of the latter was a fork on a jointed arm which swept around a vertical axis in the centre of the platform, first across the sickle end and parallel to the cutters, then gathering and compressing the grain against the circle-board, then delivering the gavel in a compressed form at the side, and out of the way of the machine on the next round. The reaping part was made as an attachment to the mower. The economy of this arrangement, and the great excellence of both mower and reaper made the Table-rake exceedingly popular and brought the house a very large trade.

In the earlier days of binders the Buckeye house placed on the market the Buckeye Platform, or Low-down binder. Although a great many machines of this pattern were sold about 1883 and 1884, it was found that their operation left much to be desired. Experiment and improvement upon this model has resulted in the Buckeye Banner binder, which is too well known in the markets of the present day to need description. Certain of the original patents on the earlier low-down, and which cover devices essential to the success of that type of machine, inure to the benefit of the Banner, which has as its specialty farms of moderate size, and harvesting on hilly land.

For large work, and for all the possible conditions of crop that a harvesting machine is liable to encounter, the Buckeye Frameless binder is placed on the market as the embodiment of the highest type of results that have been approved by modern experience and invention.

Some years since Aultman, Miller & Co. established a twine factory in connection with their harvester plant. The methods of the twine houses, and the inferior twines placed on the market, compelled this step, which has resulted most satisfactorily both to their customers and to all concerned.

In concluding this brief survey it is proper to name the man to whose inventive genius is due the wide and well-grounded reputation of the Buckeye interests, Lewis Miller. The modern mowing machine is the offspring of his brain. The Table-rake, and the characterizing features of both the Frameless and Banner binders, were his inventions. It is, however, as the inventor of the Buckeye mower, the pioneer of all mowers in those features which constitute their controlling recommendations, that he will for all time hold the highest place as an inventor who will ever deserve the meed of gratitude from his countrymen and mankind. Mr. Miller would have been entitled to rank with the foremost inventors in this class, had he done no more than to make the first successful two-wheeled machine, for this was an improvement of fully as great value as others from men whose work made them leaders in the industry. But this improvement was only the first step in the series of inventions conceived by him, which, when worked out in practice, produced the perfect hinged or floating bar of the standard mower of to-day.

Springfield, O.

THE CHAMPION SYSTEM OF HARVESTING MACHINERY.

"CHAMPION CITY" is the name that has been bestowed by common consent upon Springfield. As a result of inventive genius and business ability combined in the highest degree, Champion reapers and mowers became the exemplification of their name during the earliest years of the reaper industry, and the subsequent development of the Champion "system" of harvesting machinery has made Springfield one of the largest cities in Ohio and the second city in the world in the manufacture of agricultural implements. The inception and rise of the Champion practically covers the period of development of improved agricultural implements in America, and Springfield enjoys a position by no means the least among the centres of invention and development from which have gone forth the means of increasing five to tenfold the producing capacity of the American farmer. "Champion City" and the men of genius who have controlled the Champion system have done their part well and are entitled to a full share of credit from a grateful people.

The Champion interest was fortunate in having almost from the first an organization that was unquestionably the strongest in the reaper industry, and the result was that the production of Champion reapers and mowers multiplied until it reached 70,000 machines per year, giving Springfield the first position in this class; and in the subsequent evolutions of the trade which have carried down more than half the capital invested in this industry in the United States, the Champion has kept to the front, and to-day its organization is, if possible, stronger than before, in the hands of the pioneer house that established the reaper industry in Springfield.

The manufacture of reapers was begun at Springfield in 1850 by Benjamin H. Warder. Mr. Warder had come to Ohio from the east at an early day and settled in Springfield. The water power available here induced him to establish a saw mill, later a grist mill and woolen mill, and a factory for making small agricultural tools which was soon developed into a reaper factory, and still later he established a shop for making wagons, plows and other agricultural implements. The introduction of the hand-rake reaper by Seymour & Morgan, of Brockport, New York, attracted Mr. Warder's attention in 1850, and he bought an interest in the patents, paying what was then considered an enormous sum for an investment of so uncertain a character, \$30,000. He at once began manufacturing this reaper on a large scale and introduced it throughout Ohio and the west; and a few years later, when Seymour & Morgan had perfected the New Yorker self-rake, he took a license under the patents on it. In this way the reaper industry began at

Springfield, the New Yorker reaper, or combined reaper and mower, as it was made by Mr. Warder, becoming the nucleus of the Champion system. As the country developed the business grew rapidly and taxed Mr. Warder's resources to the utmost to extend his facilities for manufacturing so as to keep pace with the demand during the years prior to 1860, and later, during the Civil War.

During these years the industry had been gathering recruits. Early in the "fifties" Mr. Warder associated with himself J. C. Child, adopting the firm name of Warder & Child, and continued under this style until January, 1866. In the meantime Mr. Warder had performed a duty that few of the manufacturers in his line undertook: he had gone to the front during the Civil War and served as lieutenant of a company organized among his men. In his absence from Springfield the business interests of his firm were looked after by his partner, Mr. Child, and by Ross Mitchell and J. J. Glessner. While in the service Mr. Warder became intimately acquainted with A. S. Bushnell, who was serving as captain of the next company in their regiment. The friendship thus established grew stronger as the great struggle neared its close and led to Mr. Bushnell becoming actively interested, upon his return home, as a partner in the Springfield business, with which he had been identified in a small way some years before. In 1866 Warder & Child dissolved and a new firm was organized under the name of Warder, Mitchell & Co., consisting of B. H. Warder, Ross Mitchell, A. S. Bushnell and J. J. Glessner. This arrangement expired by limitation in 1879, and the firm was then organized as Warder, Bushnell & Glessner, Mr. Mitchell retiring.

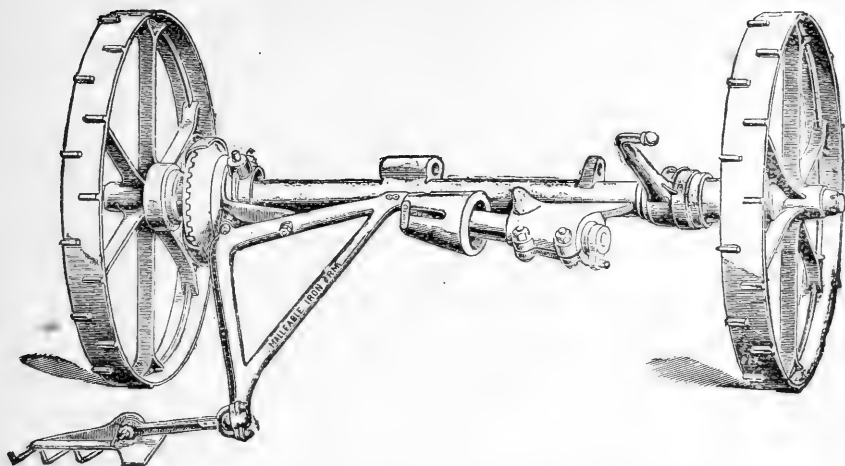
The reaper industry had other recruits also in these early days. In 1851 a reaper trial had been held near Springfield, at which all the machines then in competition in the trade were entered. A young farmer's boy who witnessed this trial, William N. Whitely, was destined to become famous in later years as identified with the Champion system, winning in fact, the popular title of the "Reaper King." In 1852 he built his first machine, with a view to making a combined reaper and mower. An improved experimental machine was built by him in 1853, and used in 1854, and in 1854-5 he perfected and began in a small way to manufacture the first successful combined self-raking reaper and mower that was put on the market. This was an important step in the development of harvesting machinery, one that was destined to win for its inventor a foremost place and a full share of credit in the development of the Champion system. In 1856 Mr. Whitely entered into partnership with Jerome Fassler and O. S. Kelly, under the name of Whitely, Fassler & Kelly, and they began the manufacture of Whitely's machine, overcoming gradually the difficulties incidental to pioneer work, and becoming firmly established by 1860. From this time on the new firm grew in influence, and came into competition with the older house alongside of which it was working. This competition eventually became keen and continued until 1867, when overtures were made for a division of territory and a consolidation of their machine interests, so that each house could conduct its business without demoralizing rivalry. Recognizing valuable features in Whitely's machine, the Warder interest

readily assented to this proposition and terms were agreed upon in the fall of 1867. In carrying out the plan the Champion Machine Company was organized to handle territory ceded to it by the two old houses, and Mr. Whitely's brother became prominent in it.

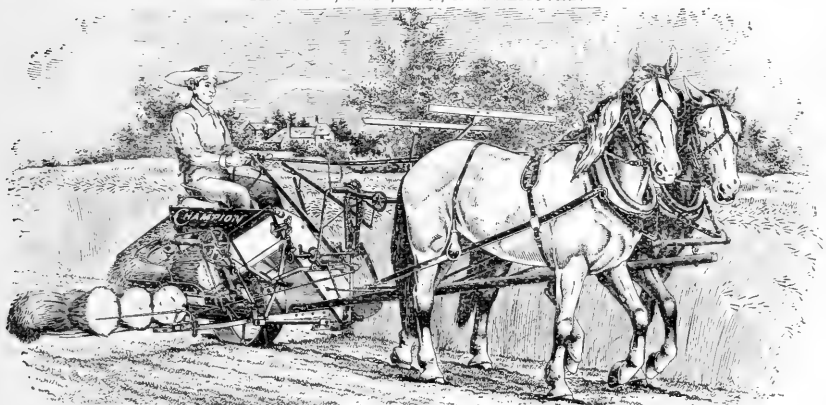
This consolidation of interests was a fortunate step. It gave to Springfield a strength of organization that was possessed by no other pioneer manufacturing center in the entire industry. By its terms Mr. Warder and his associates had the lead in the business management of the Champion interests, Mr. Whitely was placed at the head of experimental work for the three houses, and Mr. Fassler, unexcelled as a mechanic and superintendent, organized their factory methods. The needs of the west for harvesting machinery gave a new impetus to the demand for the Champion, and after eighteen years of pioneer work Warder, Mitchell & Co. were able to accumulate a surplus beyond the requirements for enlarging their facilities. Hitherto their business had absorbed in its growth all the profits that could be made from the manufacture and sale of their machines. Springfield sent out better machines than ever before, and was able to market them to better advantage. The good points of both systems were combined in the new Champion interest and a series of improvements was begun that far increased their lead in the reaper industry. The use of malleable iron in machine construction was introduced in the trade by the Champion interest, a malleable iron foundry having been established in 1874 by the three houses. A few years later an equally important step was taken in the introduction of steel construction in their reapers. The Champion interest was also noted for the care given to details in the manufacture of their machinery and for the high grade of materials which they used. Still another influence that has operated in Springfield's favor, and that becomes more striking as the years pass, is that her workmen have "grown up" to the harvesting machine industry, and are familiar with its details from their boyhood. They are almost entirely American born, and having been bred to this business have a peculiar adaptation to it, and their industrious habits and high character have without doubt imparted, in some degree, at least, a higher character to the machines they make.

It was the original intention of the parties to the consolidation of 1867 that the Warder interest should in time (after a certain number of machines had been manufactured), assume control of the business management and the entire trade of the Champion interest, but this agreement was not carried out, and the three divisions of territory and three business organizations were kept distinct until the lamentable failure of Whitely, Fassler & Kelly in 1887, and the withdrawal of the Champion Machine Company from the business. At this time, however, Warder, Bushnell & Glessner purchased the rights of these two houses, and enlarged their facilities to provide for the increased obligations in furnishing Champion machinery for the entire country. To strengthen their position under the new responsibility the firm incorporated as the Warder, Bushnell & Glessner Company.

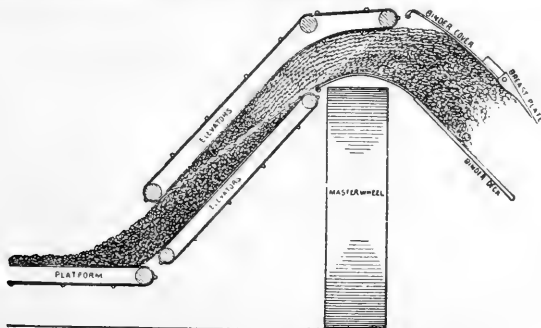
The business of the Warder, Bushnell & Glessner Company has increased steadily from the day it was established by Mr. Warder, in 1850, having had a gradual, conservative growth, without strikes, financial difficulties or other



OUTLINE VIEW OF CHAMPION MOWER SHOWING THE ONLY GEARING USED
THE POLE, SEAT, ETC., ARE REMOVED.



THE NEW CHAMPION BINDER.



ELEVATOR ON NEW CHAMPION HARVESTER. THE DEFLECTION OF THE UPPER CANVAS CHANGES
THE DIRECTION OF THE FLOW OF THE GRAIN AND FEEDS THE GRAIN INTO THE PACKERS.

set-backs. For a generation they have operated one of the very largest factories in the world, and they have made as many machines during their career as any other harvesting machine house. Their machines have always been the best that mechanical ingenuity and skill could make from the best material obtainable, and the company's financial position, as a result of their long and successful career, is second to none, a circumstance that augurs well for the future of the Champion. Mr. Warder is one of the two survivors of the pioneers in the reaper industry, and though he no longer takes an active part in the management he retains his financial interest.

Their facilities for manufacturing have been enlarged from year to year, the latest step in this direction having been the erection during the past year of a mammoth foundry. This building is more than 1,000 feet in length, covering about two acres, and is equipped with the latest mechanical devices for facilitating work, including a system of heating and ventilation that changes the atmosphere once in five minutes and carries away the smoke and gases that have hitherto made foundries so disagreeable. These annual improvements are necessary because the Champion is increasing its hold upon the machine trade of the world, and Champion machines are now supplied only by the Warder, Bushnell & Glessner Company.

The Champion machines are noted for their "distinctive" features. For the purpose of this sketch mention need only be made of two: the peculiar gear of the Champion mower, and the improved elevator which distinguishes the Champion binder. Their mower is popularly known in the machine trade by the name "wobble gear." This device performs with two gear-wheels the work of multiplying the speed of the driving-axle to that required for the pitman. These wheels are in mesh, facing each other, and one revolves with the driving-wheel, while the other remains stationary, except for the "wobbling" or winding motion that is transmitted to it by the driving gear, of which only a portion is in mesh at one time. One of the wheels has forty-eight cogs and the other forty-six, and the speed is multiplied twenty-three times. The gear is simplicity in itself, and minimizes friction, which reduces the draft very considerably.

The illustration shows the principle of the new Champion elevator quite clearly. In the standard elevator the lower canvas extends above the table, and the straw is likely to fall back so as to be carried down by the slats on the returning canvas. In this new elevator the lower canvas is shorter, and the grain in its upward course readily passes the opening between the roller and the curved or arched extension of the table.

HAY RAKES AND TEDDERS.

The business of the Thomas Manufacturing Company at Springfield, O., was established by J. H. Thomas & Sons, in 1873, in the manufacture of the Thomas rake. Other styles of rakes were added in later years. Hay tedders were introduced in 1882; lawn-mowers and iron pumps in 1886; the Thomas disk harrow in 1892; and for 1894 they announce the Thomas hay-loader. The business was incorporated by the Thomas Manufacturing Company in 1886, with John H. Thomas as president and W. S. Thomas, his son, as secretary and treasurer.

IRON TURBINE WIND-MILLS.

The business of Mast, Foos & Co., at Springfield, O., was established in 1875, the firm incorporating under the present name in 1880. Their product at first was the Anderson boiler, which they afterwards discontinued making. In 1876 they commenced the manufacture of the iron turbine wind-engine; in 1877, lawn-mowers, and in 1878, Buckeye pumps. Wrought-iron fence, cresting and ornamental iron-work were introduced in 1882, and in 1892 the Columbia steel wind-mill was brought out. P. P. Mast is president and J. W. Crane secretary and treasurer.

A PIONEER THRESHER HOUSE.

The manufacture of threshing machinery was begun at Springfield, O., in 1845, by John A. Pitts, one of the brothers who were the inventors of the "endless apron" thresher. The business underwent many changes, having been conducted by Pitts & McLennan, by McLennan, Cushman & Rinehart, by Rinehart, Ballard & Co., the Springfield Engine & Thresher Company, and now by the O. S. Kelly Company. The manufacture of engines was begun in 1883, and the Kelly duplex grinding-mill was introduced in 1887. The O. S. Kelly Company began the manufacture of steam road rollers in 1890, and this is now an important branch of their business, which includes the manufacture of threshing machines, swinging stackers, portable and traction engines, horse powers and steam road rollers.

GRINDING MILLS AND CORN HARVESTERS.

The Foos Manufacturing Company was established in Springfield, in 1883, for the manufacture of the Scientific grinding mills. In 1890 they commenced the manufacture of sled corn harvesters, and introduced a line of corn planters in 1892. G. S. Foos is president; R. H. Foos, vice-president; W. F. Foos, treasurer; H. S. Bradley, secretary, and James F. Winchell, superintendent.

PIONEERS IN ENSILAGE CUTTERS.

The E. W. Ross Company of Springfield, are pioneers in the manufacture of ensilage cutters in this country. The nucleus of their present business was established at Fulton, N. Y., in 1851, by E. P. Ross. Hay and fodder cutters were manufactured on a considerable scale at that time, in connection with a jobbing and repair business in machinery. A few years later Mr. Ross became interested in paper mill machinery, but continued the manufacture of feed cutters, and in 1877 or 1878 made and put out the first ensilage cutters. In 1885 the concern removed to Springfield, O., and during the past five years has added a large line of sweep and tread powers, grinding mills and other implements. In 1890 the business was incorporated under the name of the E. W. Ross Company, with E. W. Ross, a son of E. P. Ross, as president. Since the death of E. W. Ross in 1892 the presidency has devolved upon his widow, M. F. Ross. N. Fitch is vice-president and general manager and S. E. Lincoln, secretary.

A PIONEER GRAIN DRILL HOUSE.

The business of P. P. Mast & Co., at Springfield, was established in 1856 by John H. Thomas and P. P. Mast, under the firm name of Thomas & Mast. The lines of manufacture in which they first engaged were grain drills and cider mills, but they soon after became interested in other implements. Early in the "sixties" they began making straddle row cultivators, and took out many patents covering improvements in this line. In 1871 Thomas & Mast dissolved partnership and the business was continued under the present name, P. P. Mast & Co. The firm is now incorporated, with P. P. Mast as president and C. R. Crain as secretary and treasurer.

DOUBLE DISTRIBUTER GRAIN DRILLS.

The business of the Superior Drill Co. was established at Springfield in 1867 by Ferrell, Ludlow & Rodgers, in the manufacture of grain drills under the "double distributor" patents of C. E. Patric. In 1872 John H. Thomas purchased the interest of Ferrell and the firm became Thomas, Ludlow & Rodgers. A reorganization took place in 1883, when the firm incorporated as the Superior Drill Co. Many improvements have been made in force feed grain drills, the most important of which is the disk wheel for regulating the amount of grain to be sown. This device was patented by Mr Patric in 1881.

Mansfield, O.

THE AULTMAN & TAYLOR MACHINERY COMPANY.

THE manufacture of Aultman & Taylor threshers was established in 1867 at Mansfield, O., by Cornelius Aultman and H. H. Taylor, under the name of the Aultman & Taylor Company. Mr. Aultman was one of Ohio's pioneer manufacturers as the head of the firm of C. Aultman & Co., at Canton, where the Buckeye mower was developed and for many years manufactured, and also "endless apron" threshers, horse-powers, and other lines of agricultural implements. Henry Hobart Taylor had taken the general agency at Chicago for C. Aultman & Co. in 1865, and had built up a large jobbing business in agricultural implements at the time the Aultman & Taylor Company was organized. Recognizing the elements of success in the new "vibrator" threshers, Mr. Taylor succeeded in enlisting Mr. Aultman in this enterprise. The new machines, under the trade-mark name of the "starved rooster," soon became well known, and the company has become one of the largest in the thresher industry. The house is now incorporated as the Aultman & Taylor Machinery Company.

Dayton, O.

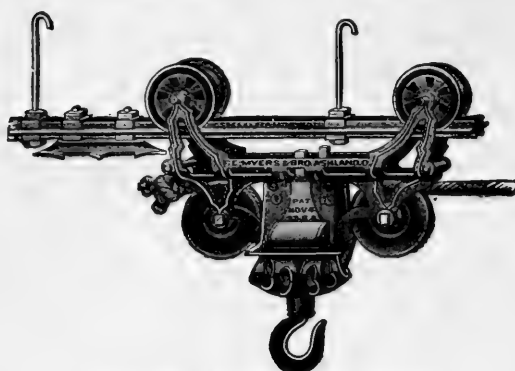
THE firm of Weusthoff & Getz, in 1870, laid the foundation of the business that is now conducted by the Farmers Friend Manufacturing Company, at Dayton, it having been incorporated under the present name in 1870. Grain drills have been manufactured from the first. In 1879 a line of corn planters was added, spring tooth harrows being introduced in 1886, and hay loaders and lawn mowers in 1888. The only important change in the management of the business was in 1887, when J. W. Stoddard, of the Stoddard Manufacturing Company, became president. V. P. Van Horne is secretary and J. F. Campbell, treasurer.

The business of the Stoddard Manufacturing Co., at Dayton, was established in 1875, by J. W. Stoddard & Co., the firm consisting of J. W. and E. F. Stoddard and W. A. Scott. The Tiger hay rake was one of the first implements introduced by the firm, and they have since added other styles of rakes. They were among the earliest manufacturers of disk harrows, and it is still a large department of their business. Recently the Havana press drill has been introduced and also the Beck side delivery hay rake.

Ashland, O.

HAYING TOOLS AND PUMPS.

F. E. MYERS & BRO. of Ashland, O., were one of the pioneer houses in haying tools, represented at the Columbian Exposition. One of the first patents issued on steel track was to P. A. Myers in 1884, and a



THE MYERS REVERSIBLE HAY CARRIER.

later invention, double rail steel track, has been generally introduced by this firm, as well as reversible carriers and other lines of haying tools. F. E. Myers became interested in the implement trade in 1870, and in 1876 he and his brother, P. A., established an implement store in Ashland, one of the most complete of its kind in the state.



THE MYERS GLASS VALVE SEAT.

This and other interests led them to begin manufacturing a few years later. They became interested also in pumps, and in 1883 P. A. Myers invented the glass valve seat which has become so well known in the trade as used in Myers pumps. From this time on their manufacturing interests enlarged and F. E. Myers & Bro. have become known among the leading manufacturers of Ohio. They are largely interested in the Bucher & Gibbs Plow Company, of Canton, F. E. Myers having become identified with this house by traveling for them, becoming

their superintendent of agencies in 1885, at the time of their incorporation.

Hoosick Falls, N. Y.

THE WALTER A. WOOD REAPER AND MOWER INDUSTRY.

NO name has become better known to the world than that of Walter A. Wood. The highest honors that can fall to any man were his, and at his death a wave of sympathy flashed from continent to continent, finding nowhere a community in which the news might be welcome, as would be the death of some great general who had wrought devastation and misery. Walter A. Wood lived the peaceful life of an American citizen; and the admiration of all who knew him, for his high character and sterling integrity, was only surpassed by the homage paid him as one of the foremost of America's inventors and business men. As a result of his genius and industry Hoosick Falls has become one of the best known manufacturing cities in the world. Beginning in a small shop, with limited capital, the manufacture of mowers and reapers, established by him, grew until the shores of the American continent were no longer the boundaries of the people favored by the possession of his improved machinery. Wherever grass and grain were grown the name of Walter A. Wood became known and his machines were foremost in foreign lands among the inventions that have given the American people the reputation they enjoy for ingenuity and skill.

Mr. Wood was of New Hampshire birth and in his early years assisted his father at wagon and plow making, developing great mechanical skill and taste. When twenty-one years of age he left home for Hoosick Falls where he engaged in the blacksmithing department of the manufacturing establishment of Parsons & Wilder. Here he remained about four years and gained the reputation of being the best workman in the shop. He then went to Tennessee and after a time engaged in wagon making, during which service he wrought the iron work for a carriage of President James K. Polk. Returning to Hoosick Falls, he entered into partnership with John White, under the name of White & Wood, in the manufacture of plows and other foundry products, continuing until the fall of 1852, when this connection was severed.

At this time Mr. Wood became associated with J. Russell Parsons in the firm of Wood & Parsons, for the manufacture of mowing and reaping machines under the patents of John H. Manny, of Illinois, the firm having purchased the rights under the Manny patents for the state of New York. The following year Wood & Parsons dissolved partnership and the business was continued by Walter A. Wood, who, as his biographer has said, "Had at last found the proper field for the exercise of his inventive genius, indomitable energy and tireless industry." In 1855 Mr. Wood purchased the Tremont cotton mills and fitted up the buildings for the manufacture of his

reapers and mowers. The original Manny machine was a crude affair and would scarcely be recognized as a reaper by the farmer of to-day, but Mr. Wood's inventive genius soon wrought important changes, amounting to a revolution, in its design and construction.

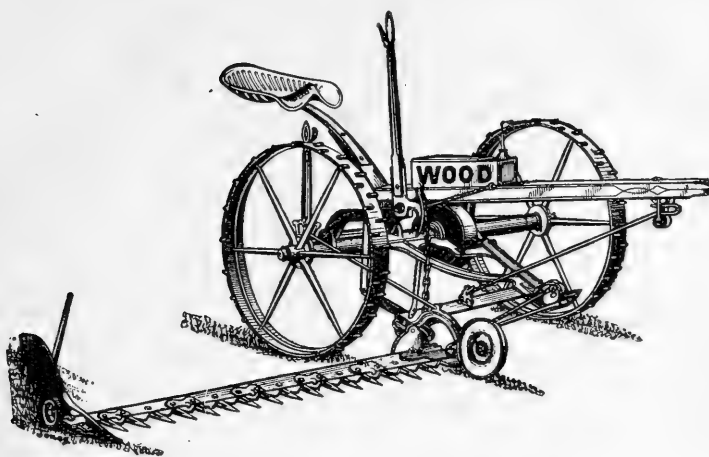
The first Walter A. Wood machine was introduced into England in 1856, where its initial work was done on the estate of the late Prince Consort at Windsor. It soon became well-known in England and an agency was established in London for its sale, this laying the foundation for the enormous foreign trade that the company have since developed.

In 1860 fire swept away their buildings at Hoosick Falls, but they were rebuilt in time for the next harvest. In 1861 the first self-raking reaper put on the market under Mr. Wood's patents was introduced, important improvements being made in its design in 1863. In 1865 the demand for Mr. Wood's machines had increased so considerably that it was necessary to greatly enlarge their facilities for manufacturing, and the business was incorporated under the name of the Walter A. Wood Mowing & Reaping Machine Company, of which Mr. Wood became president, holding that office until his death in 1892.

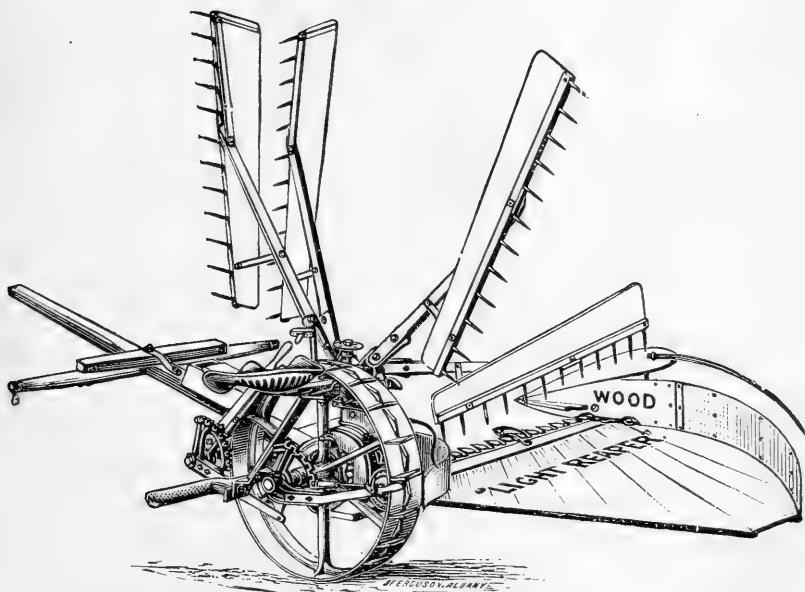
In 1870 the works were again entirely destroyed by fire, but, fortunately, an adjoining mill building had been acquired the year previous, and it was possible to fit this up and partially supply the demand of the harvest of 1870. The works were then rebuilt on a far larger scale and with a convenience of arrangement that was possible in laying an entirely new plant. From this time on, as the influence of the house grew throughout the world, new buildings and additions were required, until to-day the works rank among the very largest of the world's factories. In the meantime Mr. Wood had brought out several machines that were destined to play an important part in the history of harvesting machinery.

The first automatic grain-binder ever put on the market was the Locke machine made by the Walter A. Wood Company. As early as 1861 Sylvanus D. Locke, to whom the invention of the machine is to be accredited, began experiments looking to a machine that would bind grain with wire; and he continued in this effort until 1869. In 1870 the first machine of this type that was fully successful was put in the field near Hoosick Falls, Mr. Wood having arranged in 1869 to take up the burden of introducing it on the market. The fire of that year prevented extensive experiments, but in the two succeeding years considerable work was done. In 1874 twenty-five machines were built; in 1875 three hundred; in 1876 twelve hundred, and in 1877 three thousand machines. In 1878 the Walter A. Wood enclosed gear mower was introduced, the sales of which have since run into the hundreds of thousands.

Many other important machines have been designed and perfected at the Hoosick Falls works, making the line of the Walter A. Wood Company complete in mowers, reapers and binders. Probably their greatest success in pioneer work has been achieved with the Holmes twine-binder, which divides the honors with the Appleby type of machine in the harvest fields of the world. There are many distinctive features in the Holmes binder, the chief of these being in the rotary packer, in the style of knotter that



WALTER A. WOOD "ENCLOSED GEAR" MOWER.

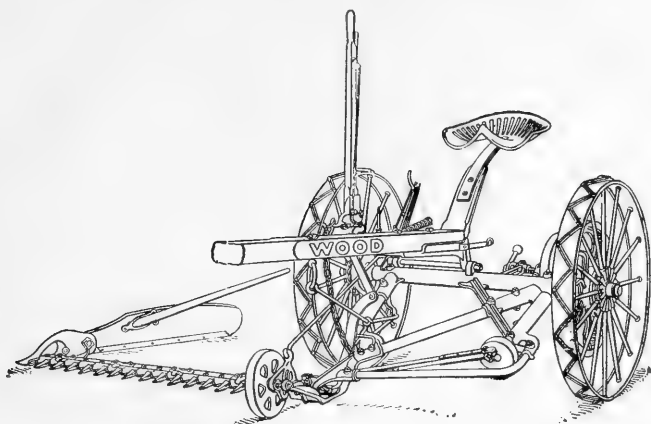


WALTER A. WOOD "TUBULAR STEEL" REAPER.

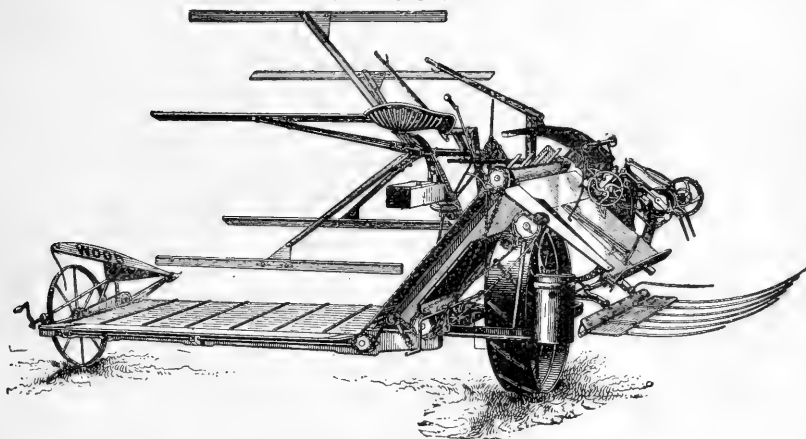
is used and in the dischargers. The packers in use on the Appleby binder are reciprocating, while those in the Wood binder rotate and are continuously in contact with the grain, causing less vibration. The knot-tying device of this binder is reciprocating, and many advantages are claimed for it in simplicity of operation. The dischargers operate in a way that does not permit of winding, so that the bundle carrier may be piled high with sheaves. Still other important features are noticeable in this binder, but it would be impossible to describe them in detail. They are well known to all who are in the field, or who are familiar with this class of machinery.

The company have lately introduced the Walter A. Wood tubular steel mower. The remarkable feature of this machine is that it is constructed almost wholly of steel, the frame being made of steel tubing. The wheels of this mower are of steel, made under special machinery. The axle is of steel, and has no holes to weaken it. The tread of the machine is changeable, for different widths of cut, this adjustment being secured by a peculiar device, the Wood "axle-extension." The bar is so hung that the guards rise easily over obstructions, and at the same time the sections droop in front. Lightness of draft is a special aim in this mower, and is gained by the large journals used, with brass bushings, and by making every point in the construction of the machine conform to the highest possible standard. As a result the tubular steel mower has become known as the leader of light draft machines. The Wood "tubular steel" reaper has become favorably known throughout the world, and scarcely needs comment. It is an excellent machine, and has done good work in every part of the world where grain is grown.

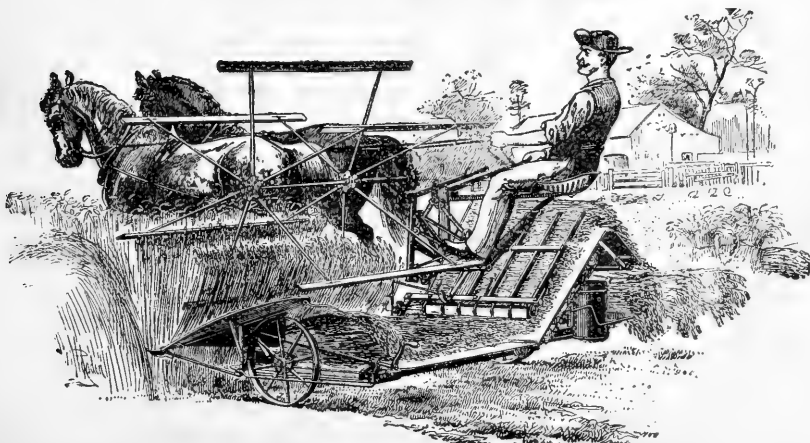
It is doubtful if any American house has taken more medals and awards at international expositions than the Walter A. Wood Company. Certainly no manufacturer of harvesting machinery has done so. In 1862, at the first international trial of harvesting machines held in England, the Wood machines were awarded the "medal of merit," the highest honor conferred by the Society of Arts of England. In 1867, at the Paris Universal Exposition, the Wood machines were awarded the "iron and gold medal of honor," the highest distinction conferred, and they won in addition the first prize in the great international field trial. The next victory was in Vienna, in 1873, at the International Exposition, where a "grand diploma of honor" was awarded to Wood. A like award was made at the Centennial Exposition at Philadelphia, in 1876. At the Paris Exposition of 1889 Mr. Wood took the first honors for his standard binders, and exhibited and successfully operated his straw-binder. Altogether the Walter A. Wood machines have been awarded about 1,200 medals by various expositions and societies.



WALTER A. WOOD "TUBULAR STEEL" MOWER.



WALTER A. WOOD "SINGLE APRON" BINDER.



WALTER A. WOOD "SINGLE APRON" BINDER IN GRAIN.

Auburn, N. Y.

THE OSBORNE SYSTEM OF HARVESTING MACHINERY.

AUBURN, New York, has been known for nearly forty years as one of the leading cities of the world in the development and manufacture of grain and grass cutting machinery. It was in western New York, in a section of country tributary to Auburn, that Ketchum and Forbush and Kirby conceived and worked out in practice the vital principles of the old rigid bar mowers, and it was here that features vital to a self-raking reaper were invented and perfected. At an early period of this development D. M. Osborne was associated at Buffalo with Forbush and Kirby, and while he was not an inventor, he had a talent as indispensable to the future of the reaper and mower industry--the faculty of discriminating between the good features and the worthless in these various inventions that were conceived by his associates. Under Mr. Osborne's wise leadership and guidance, whatever was good in these machines was preserved and fused into a composite design, and in this way abortive efforts and the work of inventors who were ahead of their time were made to bear fruit. Mr. Osborne proved to be a born leader of men, and his business and mechanical ability were of so high an order and combined in so rare a degree that within a few years he had built up out of chaos a perfectly organized system of machinery, and reapers and mowers bearing his name were in use in all parts of the world.

It was in 1855 that Mr. Osborne met W. A. Kirby in Buffalo, about the time that Kirby's patents were issued on a new style of mower that he had invented. Mr. Osborne encouraged Kirby to persevere in his efforts to get his machine on the market, with the result that seven machines were put out in the harvest of 1856. The success of these machines was such as to convince Mr. Osborne of their merit and he borrowed the money necessary, \$4,000, and purchased the interest in the patents of parties who had been associated with Kirby. The next year, 1857, two hundred machines were built, and though they were naturally imperfect in mechanical details of construction as compared with machines that had been longer on the market, the second prize was won at the great United States trial at Syracuse by one of them. At the end of the year Mr. Osborne had made enough money to pay off the debts that he had incurred and arrangements were made to manufacture the machines on a larger scale. In December, 1857, Oliver T. Holbrook, of Rushville, N. Y., became interested in the business, advancing considerable money needed to carry on manufacturing at Auburn, where the machines were built for the next harvest, in the shops of O. H. Burdick. In the fall of 1858 Mr. Osborne associated with himself Charles P. Wood and Cyrus C. Dennis as partners, under the firm name of D. M. Osborne & Co., and they took possession of the Burdick shop.

The partnership referred to lasted four years. In November, 1862, the

firm dissolved and Mr. Wood retired with some \$25,000 as his share of the profits. Mr. Osborne and Mr. Dennis then formed a new partnership under the old name, D. M. Osborne & Co., to which John H. Osborne was admitted in 1865. The close of the civil war marked an important change in the life of the northern people. The improved agricultural implements that had been brought into use had taken the places on the farm of the soldiers who were at the front, and they, returning home to find their occupation gone, turned their attention to the nation's undeveloped resources. They went to the far west, and with the aid of improved machinery such as had supplanted them at home, began the work of subduing the prairie soil. Mr. Osborne's business was bound to grow with the country, and his attention was turned early to this new development in the west. A branch house had been established at Philadelphia, and now another large agency was opened in Chicago. Later came the third in St. Louis, and a fourth in Cleveland. In 1866 the death of Mr. Dennis dissolved the partnership, but a new firm was organized, O. H. Burdick taking Mr. Dennis' place.

In 1866 occurred one of the most important events in the history of the agricultural implement industry, the great reaper trial at Auburn, held under the auspices of the New York State Agricultural Society. There were entered in competition 44 mowers and 30 reapers. The list of judges included several eminent men, among them Ezra Cornell, of Ithaca. D. M. Osborne & Co. won the first prize for a hand-raking reaper, and second prize for a one-horse mower.

In 1872 Mr. Osborne carried out a purpose he had long kept in mind, to take an extended trip abroad, and make better arrangements in the principal foreign countries for the sale of his goods. As a result of this trip European agencies were established at Bremen, Paris, Liverpool and other points, and the next year a large exhibit was made at the Vienna Exposition. This laid the foundation for an extensive foreign trade that is still on the increase, having far exceeded the boundaries that were originally in view.

In 1875 D. M. Osborne & Co. absorbed the business of the Cayuga Chief Manufacturing Company, and in this way secured an important addition to the Osborne system of machinery. The organization of the company then stood as follows: D. M. Osborne, president; J. H. Osborne, secretary, and A. G. Beardsley, treasurer.

In the fall of 1876 Mr. Osborne met at the Centennial James F. Gordon, the famous inventor, who had been experimenting since 1869 with his wire-binder. Arrangements were made with Gordon and his brother by which they came to Auburn to build a self-binding harvester. The success of their work was demonstrated in the harvest of 1877, in which was witnessed an important revolution in the reaper industry. The wire-binder not only proved to be a successful machine in the field, but increased largely the demand for harvesting machinery, and paved the way for the introduction of the twine-binder, which brought a still more remarkable increase in the number of farmers who undertook to equip themselves with improved machinery.

In the sudden revolution in harvesting machinery that followed the

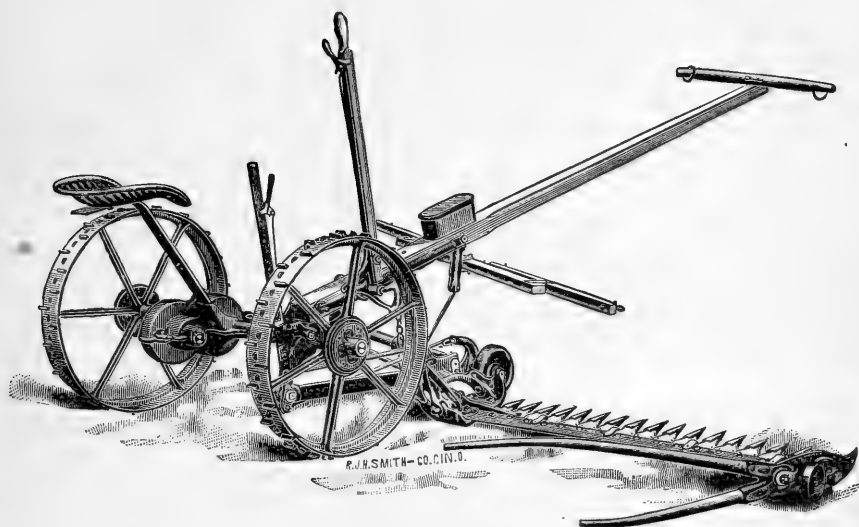
invention of the Appleby binder, Mr. Osborne played a prominent part. His first machine, placed on the market in 1882, was a modification of the Gordon binder, adapted to use twine instead of wire. The experience of that year, however, demonstrated the superiority of the Appleby machine, and Mr. Osborne took a license to build it. Not content with the standard machine as generally made at that time, he set about improving it, and the remaining years of his life were given to its development. That they were fruitful years may be known by the fact that the Osborne machine was the first in the field with a steel frame, an improvement of far-reaching importance. It has ever since been a subject of remark among machine men that just as he had overcome the difficulties incident to pioneer work with a new invention, especially after the change to steel, in which he led the industry, his health should have entirely failed him, death following a few months after. But the legacy which Mr. Osborne left the world in the Osborne system of harvesting machinery is a sufficient monument to his name, one that will endure as long as grass and grain are grown.

The new Osborne twine binder retains the distinctive features that Mr. Osborne left upon it, with improvements that might be expected from the fertile minds of the experts who survive him, and whose lives are pledged to maintain the standard that he set up.

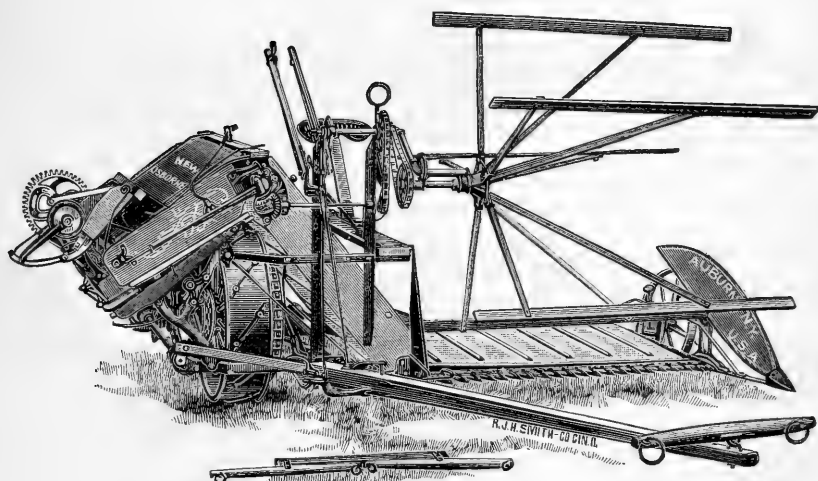
The peculiar construction of the steel frame is retained in the steel angles put together with malleable corner irons and held by steel bolts and nuts, making it well-nigh indestructible and preventing any sagging or springing. The sickle is driven in front by a straight drive, in a simple and effective manner, directly from the crank-shaft in front of the drive-wheel, thus securing great power. In the Osborne knotter a swinging disk or twine-holder is used. The most difficult problem in a knotter is to be able to tie successfully the different qualities of twine found on the market. This swinging disk enables any kind of twine, large or small, to be used. When the twine is closed in the disk, and as the knotter begins to tie, the disk rises and yields the twine to the knotter-hook. With this swinging disk but little strain is left on the twine, except that due to the expansion of the bundle when it is discharged by the binder. The machine is equipped with all of the latest devices in the tilting apparatus, the steel sheaf-carrier, transportation trucks and the clover and flax attachment.

The Osborne No. 4 mower has many points of excellence. The main frame is cast in one piece, and is compact and strong, thus insuring easy and steady motion of crank-head pitman. There are four pawls in the drive-wheel, which are interchangeable. They take up all lost motion, the knives are kept in constant motion, clogging cannot occur, and the knives are set in motion the moment the horses start. The gearing is completely inclosed, excluding all wet or dust.

At Mr. Osborne's death the presidency of the company devolved upon his son, T. M. Osborne, who has risen to the difficulties of his position with an energy that augurs well for the future of the Osborne system. J. H. Osborne, a brother of the late president, is secretary, and E. D. Metcalf treasurer.



THE OSBORNE NO. 4 MOWER.



THE OSBORNE TWINE BINDING HARVESTER

Brockport, N. Y.

THE OLDEST REAPER FACTORY IN THE WORLD.

THE oldest reaper factory in the world is located at Brockport, N. Y. In 1844 Seymour & Morgan established a shop at Brockport, known as the Globe Works, for the manufacture of agricultural implements, and quite a business was built up. The beginning of the manufacture of reapers on a successful scale dates from the time that Cyrus H. McCormick was induced to come to Brockport to build his machines.

Mr. McCormick had met, while in Washington attending to his patents, the Hon. E. B. Holmes, member of Congress from Brockport, who told him about these new works and of the men in charge, and advised him to go there. The machine which he brought with him for the inspection of Seymour & Morgan was very crude. There was no driver's seat, and the man who raked off walked along beside the platform. The gearing was imperfect, and the sickle was but a thin, straight strip of steel, on the front edge serrated reversely every four or five inches of its length, and liable to be clogged at the slightest provocation. Yet, though so coarse, immature and imperfect, it was a machine with which it was possible to cut grain when the conditions were all favorable. Various trials, however, suggested various improvements. It was cut down a little here, strengthened a little there, and generally brought into better form. The raker sat astride a saddle provided for him in rear of gearing and used an ordinary hand-rake; but the driver rode a horse or walked, for still there was no seat. The result of the negotiations and experiments was that an arrangement was made whereby Seymour & Morgan engaged themselves to build a quantity of McCormick's reapers, as improved, for the following season's harvest; and in pursuance of this arrangement there were built at the old Globe Works by Seymour & Morgan for the harvest of 1846, one hundred of these reapers, the first quantity of harvesting machines ever built by one concern, put upon the market and sold; and thus the old Globe Works became the first reaper factory in the world.

As an example of the undeveloped condition of manufacture at that time, it may be stated that a portion of the peculiar spear-shaped guard-fingers of this first hundred machines was let out to country blacksmiths in the vicinity, who forged them for twenty-four cents each, and the machine bolts also at four and a half cents; the iron, cut to proper length for each, having been furnished them by Seymour & Morgan. The next year by the use of swages the guard-fingers were made at the shops and at less than half the cost. A little later they made them of cast iron; and thus the first guard-fingers were brought out.

The manufacture of these crude reapers was a bold venture on the part of Seymour & Morgan, and required unusual nerve, which both had in a high degree, but Dayton S. Morgan, the junior member, had, in addition to his push and energy, a prescient eye; he saw in the new machine its promises and possibilities, and he took his share of the risk with the fullest faith in his foresight. Reaping by machinery, incredible as may now seem the statement, was then considered by most people who claimed an average share of intelligence and common-sense, entirely impracticable, and it was difficult indeed to find parties with sufficient boldness or pluck and energy to undertake the hazardous enterprise of building reapers, and quite as difficult to prevail upon farmers to take the chances of cutting their grain with them, or to look favorably upon such an innovation. But the hundred machines made that year operated successfully; they were sold and settled for, and their advent inaugurated a revolution in the manner of cutting and harvesting grain, for up to that time the cradle had been the most improved implement used for the purpose.

Seymour & Morgan continued the manufacture of McCormick machines under license until 1848, when the original patent expired. They then introduced the reaper known as the "New Yorker," which gained a world-wide reputation, and was universally acknowledged as the best machine of its day. It was a hand-raking reaper, with stand for raker and forker, seat for the driver, and with scalloped serrated sectional sickle substantially the same as now used. For the harvest of 1851 they ventured to make 500 of these machines; and people wondered how and where they could possibly be sold. About this time Mr. Morgan purchased of Mr. Seymour the patents that controlled this reaper. Later it was made a combined reaper and mower and was put upon the market extensively. Meantime a self-raking attachment had been invented and developed for the machine. The first application of the quadrant platform and automatic rake to the New Yorker was made in 1850, and the first in use in the harvest of that year. Further tests were satisfactorily continued in 1851, and in the years following by putting out a few which were the first successful "self-rakers" on the market; and in 1854 the manufacture of the "New Yorker self-raker" in quantities for the trade became the regular business of the concern.

Seymour & Morgan are thus entitled to the rank of the pioneer house in reapers, as they not only built the first lot of fully successful hand-raking machines, but were the first also to make and introduce self-rake reapers.

Shortsville, N. Y.

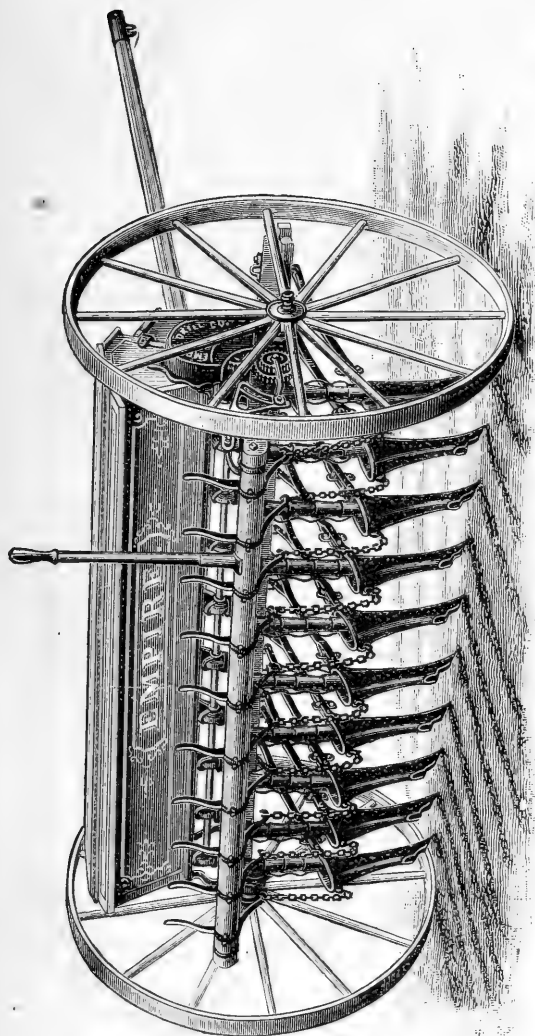
THE EMPIRE DRILL COMPANY AND THE "FORCE FEED."

WESTERN New York has been famous for fifty years or more as a wheat producing centre, and at one time stood pre-eminent for the quality of the flour made from wheat grown there. Until the decline in value of this cereal in recent years it formed the principal crop of the western New York farmer, and Rochester, commanding the Genesee valley, became known as the Flour City. The demand for land in this garden spot led to a high valuation at an early day and this in turn stimulated the farmers to more careful methods, so that the western New Yorker became noted for his thoroughness and scientific farming. These were ideal conditions for the germination of new inventions, with a view to labor saving on the farm or the more thorough performance of farm work, and hence it was that western New York produced so many noted inventors like Ketcham, Forbush, Kirby, Cyrenus Wheeler and others in the reaper industry and at an earlier day Jethro Wood, the inventor of the cast plow.

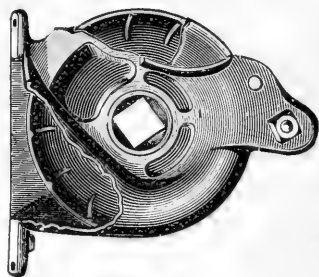
The force feed is the most important invention that has been produced in the drill industry in America, and this has been developed in western New York from the crude device of the first inventor, who conceived the idea and gave the name "force feed" to his invention, down to the latest mysterious improvement, by which the same adjustment that "sows two bushels of oats per acre will sow two bushels of wheat or any other small grain, upon the same area." To the practical drill man the feed is the vital principle, the "life" of a grain drill, and the invention of the first crude force feed may be said to have begun an era in this industry, the device having been improved from time to time until to-day it successfully performs the duty indicated by its name.

Gilbert Jessup was the pioneer inventor in this line, and Foster, Jessup & Brown were the manufacturers who introduced his invention to the world. It was a crude affair, having only a rotary disk with teeth or projections for carrying the grain from the hopper to the discharging cup, but it furnished a skeleton on which to build later improvements. Early in the "sixties" Jessup patented a new style of feed, practically a double distributor, having internal and external runs, the internal chamber or run having been used in it for the first time.

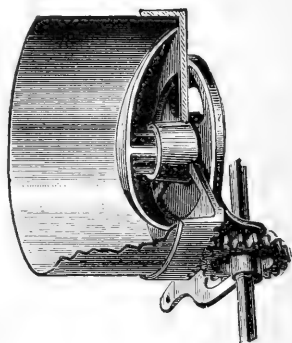
In 1854 H. L. and C. P. Brown withdrew from the firm of Foster, Jessup & Brown and removed to Shortsville, N. Y., where they established the manufacture of drills, operating under these two patents, in which they were interested. In this enterprise they were eminently successful and were able to build up a considerable demand for the new force feed grain



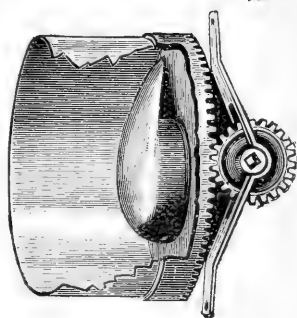
THE EMPIRE FORCE FEED-GRAIN DRILL.



THE EMPIRE FORCE FEED.



THE EMPIRE DRILL CO'S FERTILIZER FEED.



drill. In 1866 another important step was taken in the invention of a feed embodying a distributor with a single internal chamber or run adjusted to sow varying quantities of grain by changing the speed at which it was driven. This new invention at once became popular and was known to the trade as the Empire feed. The first style of feed which they made under Jessup's patent had been known as the Brown run and Jessup's second invention as the Jessup run or feed. Improvements in this new Empire feed were made from time to time with a view to making it a mechanically exact force feed. The great difficulty to be overcome was that in this, as in all other devices for distributing grain in measured quantities, there was a slight variation in the amount sowed per acre of oats as compared with wheat or other small grain. After a long series of experiments this difficulty was overcome and in 1878 the Empire feed was introduced in substantially the same style as it is known to-day.

The business at Shortsville was continued under the style H. L. & C. P. Brown, until 1877, when Oliver S. Titus and others became interested and a partnership was formed under the name of the Empire Drill Company.

Schenectady, N. Y.

A PIONEER THRESHER HOUSE.

THE Westinghouse Company, of Schenectady, N. Y., is one of the oldest thresher houses in America, having been established in 1836 by the late Geo. Westinghouse. The first product consisted of tread-powers, "ground-hog" threshers and fanning-mills. Various improvements were made, and in time "separators" were built, and other implements were also manufactured. The business was conducted by Geo. Westinghouse individually until 1851, and from 1851 to 1883 by G. Westinghouse & Co., his sons joining in the business as partners. In 1883 the house incorporated as the Westinghouse Company, the surviving sons remaining as principals. Various styles of threshing machinery are manufactured for grain, beans and peas and other crops, and also a rye thresher, with binding attachment for the straw.

Buffalo, N. Y.

THE PITTS AGRICULTURAL WORKS.

THE Pitts Agricultural Works, of Buffalo, were established in 1851, by John A. Pitts, the noted inventor. Their threshing machines became widely known as the Buffalo Pitts, the company manufacturing separators and horse-powers on an extensive scale. They incorporated in 1877, and in 1880 began the manufacture of portable, traction and straw-burning engines. John A. Pitts died in 1859 and was succeeded by his son, John B. Pitts, and James Brayley, and later by James Brayley as proprietor of the works. Carleton Sprague is now president and treasurer; C. M. Greiner, secretary and J. B. Olmsted, attorney.

Macedon, N. Y.

BICKFORD & HUFFMAN—FERTILIZER GRAIN DRILLS.

BICKFORD & HUFFMAN, of Macedon, are pioneers in the manufacture of fertilizer grain-drills. They began in 1842 as dealers and jobbers in agricultural implements, conducting also a repair business and making plows and other implements. They gradually withdrew from other lines and have since made a specialty of grain-drills. In 1870 Henry Huffman, the junior partner, died, leaving his interest in the hands of his widow, who continued as partner with Lyman Bickford. In 1885 Mr. Bickford sold out to his partner, then Mrs. Kirkpatrick, who continued the business under the old firm name, with G. W. Kirkpatrick as manager, until January, 1893, when they incorporated as the Bickford & Huffman Company. G. W. Kirkpatrick is president of the company and W. P. Thistlewaite is secretary and treasurer.

Philadelphia, Pa.

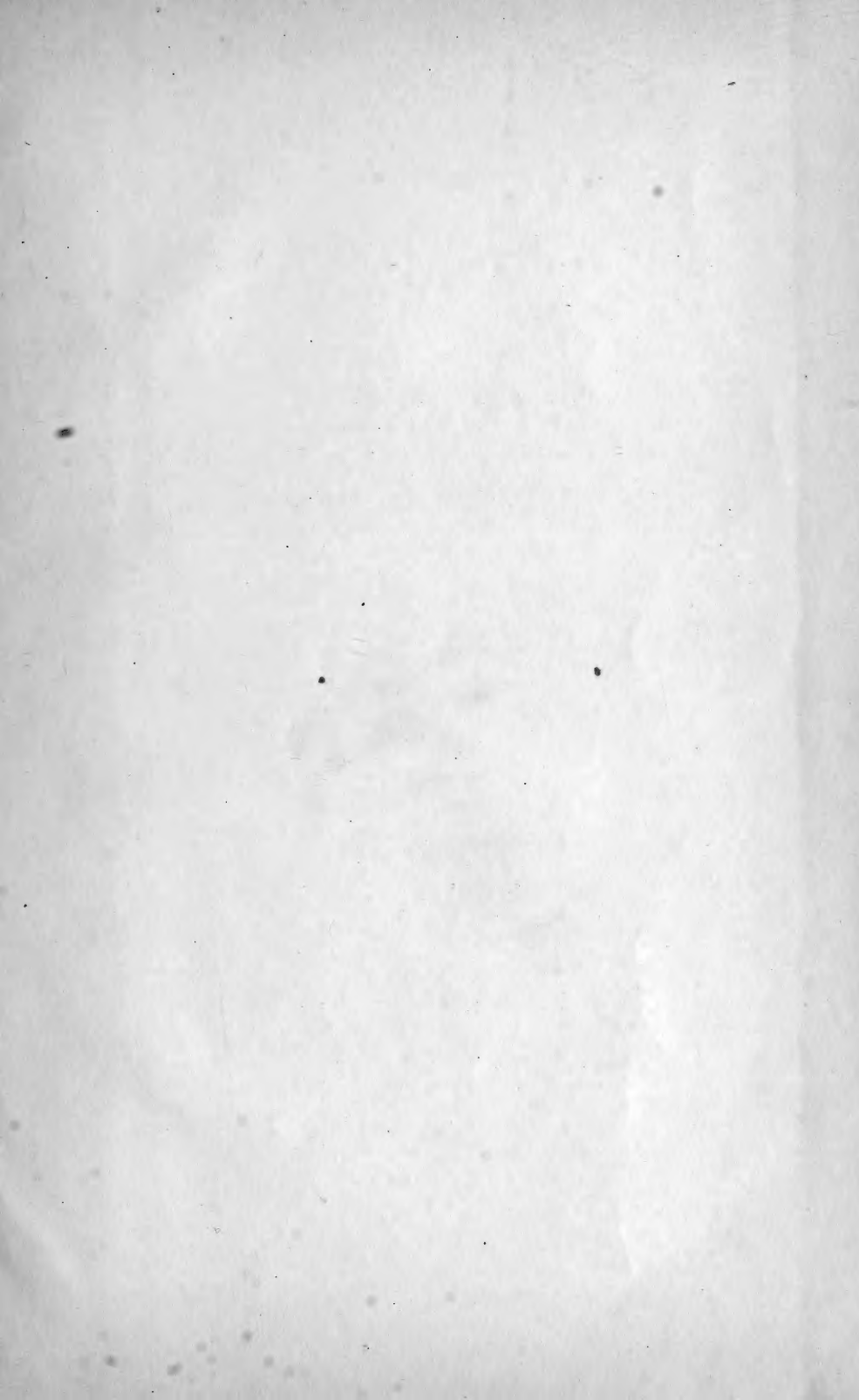
S. L. ALLEN & CO. AND THE PLANET JR. IMPLEMENTS.

THE business of S. L. Allen & Co., of Philadelphia, manufacturers of farm garden implements, dates from 1869. At this time S. L. Allen, who was a farmer and market gardener living a few miles out of Philadelphia, invented a number of improved implements, among others a seed drill, a wheel hoe, a garden plow and a horse hoe. These he had made for a time for himself and his neighbors at a blacksmith shop near by. Soon after Mr. Allen began manufacturing on a large scale, and has continued to the present time, having associated with him as partners Wm. H. Roberts and E. H. Richie. The trademarks "Planet Jr." and "Firefly" have become well known throughout the world.

Waynesboro, Pa.

THE GEISER MANUFACTURING COMPANY.

IN 1866 Daniel Geiser, now deceased, established at Waynesboro the business that was incorporated in 1869 as the Geiser Manufacturing Company, Mr. Geiser having as associates J. F. Oller, Benj. E. Price and Josiah Fahrney. They originally built the Geiser self-regulating threshers and horse-powers, beginning the manufacture of engines in 1879, when they purchased the plant of F. F. & A. B. Landis, of Lancaster, Pa. F. F. Landis took at this time the position of superintendent and in 1889 designed the New Peerless thresher. The company also make portable engines and saw-mills, and have for several years past had steam plowing outfits on the market, using their traction engine. A. E. Price is president; B. E. Price, vice-president; A. D. Morgenthal, secretary; J. J. Oller, treasurer, and F. F. Landis, superintendent.





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